2015-16

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 P. K. Singh, Director, CSIR-CIMFR welcoming Mr. Sarju Roy, Hon'ble Minister, Government of Jharkhand during 47th SSBMT organised by CSIR-CIMFR

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CSIR-CIMFR

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(Council of Scientific and Industrial Research)

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FROM DIRECTOR'S DESK

It is my pleasure to introduce our Annual Report of CSIR-Central Institute of Mining and Fuel Research, Dhanbad for the financial year 2015-2016. I have had the privilege of taking over the charge as Director of this institute in this financial year and Team CSIR-CIMFR continues to rise by leaps and bounds. For any organization, an understanding of its performance and related introspection is extremely important. This annual report presents the R&D work of scientific and technical services in concise form carried out by the institute.

It is inspiring to inform you that CSIR-CIMFR implemented 5 Grants-in-Aid, 108 sponsored and 149 consultancy projects during the financial year. Further, we have rendered the services for 31 problems for the benefit of the mining, fuel and associated industries. Our translational research has been more focused and adopted by the industry. A new dynamism has also been seen in IPR and 22 patents were granted.

We have also initiated R&D dialogue, under which lectures are being delivered by eminent academicians, entrepreneurs and young scientists. Our HRD Group has also accelerated with our scientists by supervising Ph.D and Masters Dissertation along with executive development programmes. Apart from these activities, summer internship of 125 students was also provided. We have also started a culture of organizing national seminars in Rajbhasha Hindi.

A call for our visions, missions & policies and to redefine the targets for short and long terms was fixed. This will promote rapid sustainable national techno-economic growth with equal emphasis on self-sustenance. We have committed to be an internationally acclaimed mining and fuel research organization and to develop and deliver sustainable cutting edge technologies for the social upliftment and industrial advancement.

I thank all the stakeholders for their support. I hope our scientists and staff colleagues will take a cue from the revised targets and their research will be more relevant for the betterment of the society at large and mineral sector in particular.

PK Singh

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

List of Research Council Members

Chairman

Prof. Harsh K. Gupta: Member, National Disaster Management Authority, NDMA Bhawan, A-I Safdarjung Enclave, New Delhi - 110029

External Members

Prof. Ashis Bhattacharjee: Department of Mining, Indian Institute of Technology, Kharagpur- 721302

Shri N. Kumar: Director (Technical), Coal India Limited, Coal Bhawan, 10 Netaji Subhas Road, Kolkata - 700001

Prof. Sreenivas Jayanti: Department of Chemical Engineering, Indian Institute of Technology, Madras, Chennai - 600036

Shri Anil K Jha: Director (T), NTPC Ltd., NTPC Bhawan, Core 7, Scope Complex, 7, Institutional Area, Lodi Road, New Delhi - 110003

Shri Rahul Guha: D.G., Directorate General of Mines Safety, Dhanbad - 826001

Agency Representative

Shri D.N. Prasad : Advisor, Projects, Ministry of Coal, Shastri Bhawan, New Delhi - 110001

DG's Nominee

Dr. Pradip Kumar Chatterjee: Chief Scientist & Head, Thermal Engineering Division, CSIR-Central Mechanical Engineering Research Institute, Durgapur – 713209

Sister Laboratory

Prof. S.K. Bhattacharyya: Director, CSIR-Central Building Research Institute, Roorkee- 247667

Cluster Director

Dr. M.O. Garg: Director, CSIR- Indian Institute of Petroleum, PO- IIP, Mokhampur, Dehradun – 248 005

Permanent Invitee (Head or his Nominee, Planning & Performance Division, CSIR, New Delhi)

Dr. Sudeep Kumar: Head, Planning & Performance Division, Council of Scientific and Industrial Research, Anusandhan Bhawan, 2-Rafi Marg, New Delhi-110 001

Director

Dr. Pradeep K Singh: Director, CSIR-Central Institute of Mining & Fuel Research, Dhanbad – 826 015

Member Secretary

Mr. D. Kumbhakar: Principal Scientist, CSIR-Central Institute of Mining & Fuel Research, Dhanbad – 826 015

List of Management Council Members

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

Director, CSIR-NML, Jamshedpur, Jharkhand (Member)

Director, CSIR-NGRI, Hydrabad, Special Invitee Ex-Officio Member

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

Dr. C. N. Ghosh, Chief Sct., CSIR-CIMFR, Dhanbad (Member)

Dr. Sanjay Kumar Roy, Sr. Principal Sct., CSIR-CIMFR, Dhanbad (Member)

Dr. M. P. Roy, Principal Sct., CSIR-CIMFR, Dhanbad (Member)

Mrs. Mousami Mallick, Sct., CSIR-CIMFR, Dhanbad (Member)

Sri Suman Kiran, Prin. Technical Officer, Sct., CSIR-CIMFR, Nagpur (Member)

COFA/F&AO, CSIR-CIMFR, Dhanbad (Member)

COA/ AO, CSIR-CIMFR, Dhanbad (Member Secretary)

IV. STRENGTH OF STAFF OF CSIR-CIMFR (AS ON 31.03.2016)

Group/Grade	SC	ST	OBC	General	Grand Total
Director	-	-	-	01	01
Group IV	17	08	18	98	141
Group III	14	06	21	56	97
Group II	12	04	00	45	61
Group I	18	09	01	81	109
Administrative	26	11	12	84	133
Total	**87**	**38**	**52**	**365**	**542**

V. EXPENDITURE FOR THE YEAR 2015-16

Head	Amount (₹ in lakhs)
Capital	323.334
Revenue	6741.770
Staff Quarters	18.096
Total	7083.200

1. ROCK EXCAVATION ENGINEERING

1.1 BLASTING DEPARTMENT

During April 2015 to March 2016, the Blasting Department has undertaken various assignments on blast optimization and safety related problems for mining, quarrying, construction, demolition and tunneling.

The clients included M/s Moher & Moher-Amlohri extension opencast project of Sasan Power Limited, M/s Ultra Tech Cement Limited, Jindal Steel & Power Limited, Vikram Cement Limited, Jindal Power Limited, South Eastern Coalfields Limited, Singareni Collieries Company Limited, Electr-osteel 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., National Thermal Power Corporation limited, West Bokaro Collieries of Tata Steel Limited, Indian Railways, National Hydropower Corporation Limited, J&K Mineral Development Corporation Limited, Jharkhand State Mineral Development Corporation limited, Joda West Manganese Mine and Sukinda Chromite Mine of FAMD group of Tata Steel Ltd., M/s Kayad Underground Mine, Rampura Agucha open pit as well as underground mine, Sindesar Khurd Mine of Hindustan Zinc Limited, World Bank funded projects in the state of Mizoram, Konkan Railways, Gagal Limestone Mine of M/s ACC Ltd., M/s Dalla Cement Factory and 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 slopes using smooth blasting techniques were carried out. At 2 x 660 MW STPP Khargone Project of NTPC, Madhya Pradesh, controlled blasting operations were carried out in close proximity of various sensitive structures of the plant, viz. foundations of Main Power House Building, Boiler Unit, Turbine Generators, etc. This Department has also been 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 being imparted at regular intervals for communicating the best practices to overcome the political and environmental issues.

The department has made its distinct footprint in power generation sectors like at Teesta Low Dam Hydroelectric Project, Stage-IV of NHPC at Darjeeling district of West Bengal wherein controlled demolition of coffer wall abutting the main dam structure was carried out ensuring total safety of the nearby dam structures viz. RCC Dam, Piers, gates, etc. The demolition of Railway Over bridges between Bhagalpur and Pirpainti section of Eastern Railways, Malda Division were carried out successfully with total safety of the nearby structures as well as railway track within the specified block period of 6 hours assigned by the Railway Board. The said work is a part of railway modernization planning of the Government of India to convert single-line to double-line tracks in major urban areas all over the country to facilitate infrastructure development under make-in- India programme.

To be a part of such colossal planning, the blasting department of CSIR-CIMFR was involved in the demolition of seven railway over-bridges (ROB) by controlled blasting on active railway tracks nearby populated areas in the state of Bihar. Three demolitions have already taken place amicably. The specific features of such demolition works were centred upon- (a) single-shot demolition; (b) total control of ground vibration and flyrock; (c) undamaged railway tracks and (d) six-hour block operation.

Plate-1: View of total Bridge and Railway Tracks

Plate-2: Controlled demolition of ROB

At Panthal Magnesite Mines of M/s J&KMDC, Jammu, controlled blast design patterns were evolved and suggestions were provided for the safety of various historical and mythological structures and temples of Mata Vaishno Devi, Katra. In the opencast limestone mines of M/s KJS Cement Limited, Maihar, deep-hole opencast blasting was carried out and its impact on the safety and stability of nearby structures were assessed. At Chandula-Simalgoda Stone Quarry of M/s JSMDC Limited, controlled blast design patterns were evolved for the safety of nearby village structures.

Plate-3: Controlled blasting at 2 x 660 MW STPP Khargone, NTPC, MP

Plate-4: Monitoring of vibration on the close-by concrete structures

Plate-5: View of concrete coffer wall at TLDP, Stage-IV, Darjeeling, NHPC, West Bengal

Plate-6: Opening of Additional Adit at Sawra-kuddu HE Project to speed up the HRT Excavation work

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.

The biggest and 2nd biggest blasts of India were conducted at Dragline bench of Moher & Moher-Amlohri Extension project on 13th September and 20th September, 2015. In the biggest blast, 225 holes were charged with of 980,330 kg of explosives. The average bench height of the face was 54 m and hole depth varied from 54 to 60m. The blast was conducted keeping the explosives weight per delay of 17,460 kg. The blast was initiated with Detonating Fuse and MS connectors as delay detonators. First seven rows were planned to detonate considering the concept of cast blasting while the remaining five rows were planned to minimise the throw for smooth sitting of dragline with minimum back break (Plate-6). The 2nd biggest dragline bench blast (Cut-3 Extension blast-2) of 198 holes having average bench height of 55 m having hole depth of 54 to 62 m. The explosive weight detonated in this blast was 903,340 kg of M/s SIIL. The charge weight per delay was 4,571 kg. Firing sequence of the 2nd dragline bench blast conducted on 20.09.2015 is depicted in Figure-1.

Plate-7: View of muck profile of biggest Dragline bench blast conducted on 13.09.2015

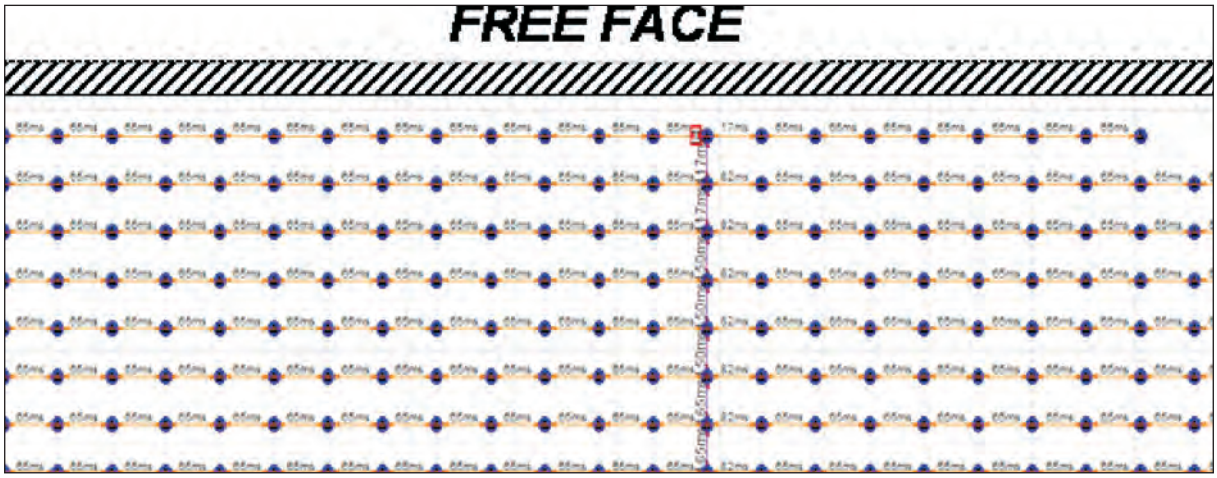


Fig. 1: Firing sequence of the 2nd dragline bench blast conducted on 20.09.2015

1.2. EXPLOSIVE & EXPLOSION LABORATORY

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

Under three continued and two new projects sponsored by M/s SCCL, total 452 samples of permitted and non-permitted explosives and accessories, comprising of 12 SMS/SME explosives, 26 LD explosives, 31 detonating fuse, 30 cast boosters, 17 cord relays, 267 nonels, 19 permitted explosives, 42 permitted detonators, 4 BG explosive and 4 permitted detonating fuse samples were evaluated for their different quality parameters at SCCL sites to advice on their quality, safety and performance parameters. Evaluation of these explosive and accessories samples of various manufacturers collected from different areas by SCCL management revealed useful information on their conformity or deviation from declared / expected values. Moreover, eight samples of permitted explosives and one sample of explosive-cord system were also evaluated for concentration of toxic gases in the post detonation fumes after five minutes of blasting at the face. Analysis of results revealed that quality of all samples of SME explosives, SMS of SCCL own plants, detonating fuse, cast boosters, explosive - cord system for BG panel were found to be satisfactory. Moreover, all samples of permitted detonators met the quality requirement of resistance, drop, snatch, series firing current, no fire current and strength parameters. Similarly, all samples of cord relays found to have satisfactory initiation characteristics. All samples of permitted explosives met the statutory requirement of toxic gases in post detonation fumes under their actual usage conditions in underground coal mines.

Out of 26 samples of LD explosives, numbers of samples which failed to meet the density, VOD and booster sensitivity are four, seven and one respectively. Photograph of sample which

Figure 1: Photographs Of Scattered Pieces Of Misfired Ld Column Explosive Salvo Power (Batch No.- 4060, Dom :- 31.12.2015) Of M/S Salvo Explosives & Chemicals Pvt. Ltd., Secunderabad

failed in booster sensitivity has been given in figure -1. All samples of permitted explosives were meeting the statutory requirements of air gap sensitivity but most of them were having their density and VOD parameters outside their expected ranges and thus failed to meet the overall quality requirements. None out of seventeen samples of cord relays and 239 out of 267 (i.e. 89.5%) of nonel samples and 16 out of 40 (i.e. 40%) permitted delay detonators samples failed to meet the quality requirement of delay timings as at least one nonel detonators of those batches was having its delay timing outside the expected range. Surprisingly, some nonel detonators with nominal delay timing of 0 ms were found to have delay timings upto 30 ms and some nonel detonators and cord relays with predefined nominal delay timings (≥ 17ms) fired almost instantaneously. A few samples of nonels misfired also because during the trails we observed that detonation wave travelled upto full length of shock tube but detonator attached at the end failed to detonate (Figure-2).

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. Different percentage of supplied blasted rock sample collected from the site of incidence of Agucha Mine of HZL were mixed with the SME explosive to study their interaction in terms of rise in temperature. 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 percentages

Figure 2: Photograph Of Misfired Nonel Of M/S Gocl
(Raydet, Tld, 25Ms, Batch / Case No. - 63 & Date Of Manufacture - 02.06.2015)

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.

In an untoward incidence on 14.11.2015 at Amalgamated Block-II OCP mine, some charged holes initiated accidentally during marching of drill machine leading to injury to drill operator and damage of drill machine. All three types of nonels were found to be in physically good condition and results of trials for quality of all three types of nonels involved in the incidence can be opined to be satisfactory as they did not initiate by impact, spark, stretching and crushing under simulated conditions.

In another incidence at Chhatarpur Mine No. 1 of Pathakhera Area, WCL, on 12.03.2016 one person got burn injuries probably because of ignition of methane / inflammable gases just after blasting operation in a development face. Studies into the safety, efficacy and other parameters of permitted explosives and detonators received from WCL are being conducted to assess their suitability for use in underground coal mines.

Under a collaborative project with M/S gulf Oil Corporation Limited, Hyderabad an improved emulsion explosive formulation meeting all statutory requirements of group P5 permitted explosive including shelf life of six months was developed. In the same project, emulsion explosive formulations meeting requirements of P1 and P3 group of permitted explosives have already been successfully developed during previous financial year.

M/s Premier Explosives Limited, Secunderabad has recently funded projects related to advice on suitability of a permitted P1 type explosive and coal delay detonators (0-6 delays) with NHN as primary charge for use in underground coal mines.

2. MINE FIRE, VENTILATION & MINERS' SAFETY

2.1. MINE FIRE

1. Advice in evaluating the incubation period of coal seam-I at 3C inclines of Sarubera (E) colliery, Kuju Area, Central Coal Field Limited, Ramgarh

A problem to determine the incubation period of coal seam-I of Sarubera (E) Colliery, Kuju Area (CCL), Ramgarh, was referred by the project officer. Accordingly, CSIR-CIMFR has taken up the problem and thus collected the coal samples from different locations of the mine panel and carried thermal mapping in concern panel. Coal samples have been analyzed through different tests and techniques for its thermal properties and tendency of coal to fire spontaneously were evaluated. Extraneous mining and environmental conditions created due to or during mining operations are also relocked. Topographic factors such as geological disturbance (faults and zones of weakness) and thermal in-homogeneity are the important contributory factors to impart the heating however in present situation their contribution is repellent. Scope of heat formation, dissipation and accumulation in the mine panel has been assessed to evaluate the incubation period. On this basis incubation period was highlighted.

2. Scientific investigation and analysis of thermal behavior of coal determining the incubation period of coal seam XVI, XVI A /XVI B and XII of Chasnalla Colliery, SAIL-ISP

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

3. Scientific investigation and advice to control the fire at Argada Quarry, Saunda Colliery, Barka Sayal Area, CCL

A problem of fire in Argada Quarry was referred by the General Manager, Barka Sayal Area, CCL for Scientific investigation and advice to control the fire at Argada Quarry at Saunda Colliery, Barka Sayal Area, CCL. The work was taken up top priority basis and thermal monitoring of the fire area has been carried out; and state and extent of fire was evaluated. Finally dealing of fires has been carried out using high pressure jet by means of water admix with fire fighting chemicals. Fire in quarry edges were brought down from blazing fire in a long area to localized heating. However, temperature on slop is still high and needs to bring down at ambient by chemical treatment. In view of the fact that quarries edges are very slant and there is every possibility that in rainy season mouth will open and aggravate the fire. Therefore it has been suggested to make a wall using wire net and boulders at a depth of 10-15 m from top edge. Length of the wall would be 50-55 m. work is in under progress.

4. Scientific Study to assess the Crossing Point Temperature and incubation period of 46LN section of Lajkura seam, Orient Colliery-3, Orient sub-Area, MCL advice thereof

Mine No.3 of Orient colliery, Orient Area of MCL, was sealed from the surface due to occurrences of spontaneous heating in below ground working. Mine management has requested to CIMFR for the study of Crossing Point Temperature and Incubation Period of the coal. After details thermo compositional study and implementing suitable prevention and control measures, the problem of spontaneous heating has been controlled. The entire mine has been reopened under our guidance in the presence of DGMS, rescue team and mining officials. In the laboratory experiments and the information provided by the mine management, the incubation period of the said mine coal is around nine months.

5. Determination of Crossing Point Temperature and Ignition Point Temperature of Seam VII and VI-B of Khairaha U/G mine, Sohagpur Area, SECL and advice thereof

For the safeguard of the mine and safe extraction of the coal from underground, mine management of Khairaha colliery, Sohagpur area, SECL (MP) referred the work of determining the incubation period of the coal. The coal samples were taken up and the properties of the coal were studied on

laboratory. Both field and laboratory investigations were carried out to determine the incubation period of seam VII and VIB of Khairaha U/G Mine. After carrying out coal characteristic parameters (proximate analysis, CPT & IPT determination, sulphur and DSC thermo-gram), analysis of data reveals that the seam VIB is more susceptible to spontaneous heating as compare to seam VII. The incubation period of the seam VI B is observed as nine to ten months whereas same study for seam VII is of eleven months.

6. Scientific study for determination of Incubation Period of Turra and Purewa Coal Seams of Nigahi project

The colliery authority were approached CIMFR to study the Incubation period of Purewa and Turra coal seam of Nigahi OCP, NCL. Accordingly, CIMFR team visited the mine, collected the data of mining details and coal samples. After carrying out detailed studies of coal characteristics parameters (Proximate analysis, CPT& IPT determination, Sulphur and DSC thermograms) reveals that the Purewa coal seam is highly susceptible to Spontaneous heating as compared to Turra seam. 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 in incubation period of Turra seam of Nigahi area may be considered as six months.

7. Scientific investigations and studies for determining the incubation period of coal within panel BBV-A of R-VIIA seam at Siduli Colliery, Kenda Area, ECL

A problem was referred by General Manager, Kenda Area, Distt. Burdwan (WB) to CIMFR for Scientific Investigation and studies to determine the incubation period of R-VII (bottom) seam of J. K. unit of Siduli Colliery.

Coal samples and exogenous data were collected from the mine panel under study of Banbahal seam. Crossing Point Temperature and Ignition Point Temperature were 102°C and 156°C respectively and seam is degree–II gassy. Banbahal seam dipping towards S74°30'E having gradient 1 in (10-12) m. Over and above, intrinsic coal characteristics and the roles of extraneous mining and environmental condition for specific site have been adjudged to evaluate the incubation period. Inferences drawn relevant that Incubation period in present condition may be projected as one year.

2.2. MINE VENTILATION

1. Scientific study on ventilation system and reorganization of ventilation system of (1) Bansara colliery, Kunustoria area, ECL (2) Hirakhand Bundia Mine, Orient Area, MCL

The ventilation investigation comprising pressure survey, air quantity survey, hygrometric survey, study of performance of fans and analysis of data have been carried out for computer simulation studies to identify parameters likely to be responsible for deteriorating the performance of ventilation system as well as computer simulation studies for assessment of the performance/ efficacy of ventilation system of the mine.

The salient features of the mines are:

Bansara colliery, Kunustoria area, ECL: In the mine total airway of length 5.5 Km have been covered during pressure survey. Air quantity at 21 locations has been measured. Wet bulb and dry bulb temperatures at the last ventilation connection of 29DS Dyke Panel and M-Top Panel are 31.5°C & 32°C and 24°C & 26°C respectively. Rise in wet bulb temperature from mine entry to the south & north panels are 8.0°C & 8.5°C respectively. In the south panel additional source of heat required special attention to reduce the heat addition to ventilating air of south workings by increasing air quantity in the mine or by providing separate route for heat removal. Overall efficiency of airshaft fan was calculated to be 30.5%.

Hirakhand Bundia Mine, Orient Area, MCL: In the mine total airway of length 7.0 Km have been covered during pressure survey. Air quantity at 35 locations has been measured. The wet bulb and dry bulb temperatures in the last ventilation connection of Panels in C-section & A-1 section was found within the statutory limit but in A-1 section panel more air quantity was required to maintain the working environment. Rise in wet bulb temperature from mine entry to panels was of the order of 4-5°C. Overall efficiency of airshaft fan was calculated to be 37.3%. To avoid the oppressive conditions in present working panels it is essential to sectionalize these developed panels.

Further, ventilation network analysis of various schemes in both the mines is in progress for suitable schemes for proper distribution of air quantity in the workings. The work is in progress in both the mines.

2. Scientific Study for formulation of guidelines on ventilation procedures for continuous miner section in RVI seam of Jhanjra Project, ECL

Based on practice elsewhere the standard air requirement is: Velocity of air at the last ventilation connection should not be lesser than 1 m/s. 2.5 m^3/min per tonne of production. 4.8 m^3/min per kw and minimum velocity of air should be 0.5 m/s in the panel. Accordingly hence the minimum air quantity requirement at the LVC of CM panel of the said mine was calculated of the order of 2500 m^3/min provided the wet bulb temperature is maintained in the range of 30.5 to 33.5°C and other contaminants are within safe limit. For higher production rate the estimation of air quantity would be determined on the basis of computer simulation studies using air quantity calculator PREDCLIM. Work is in progress.

3. Feasibility report on methodology for retardation of fire in X seam at East Bhuggatdih colliery, BCCL

The fire was initiated in July 2006. Assessment of status of fire was undertaken to facilitate trench cutting operation. Initially, a logistic model, viz. Pressure model, Temperature model and Gas gradient model of the fire representing upstream, active location and downstream of fire have been developed using results of measurements of temperature & pressure and results of air samples collected through boreholes drilled at strategic locations. The developed models have also been verified and found to be in good agreement with the US Mine Fire diagnostic model. On the basis of logistic models the fire was found to be progressed in creeping manner towards W-S side from N-E boundary of the mine. Till July 2011, fire had reached close to RSP college boundary after traversing a distance of 160m within 61 months-time at an average speed of 2.45 m/month. Lastly, in January 2015 the area within RSP college campus was found under the influence of fire. Apprehending delay in trench cutting a comprehensive technology comprising of major activities, viz.(i)Plugging of venting fissures.(ii)Cooling of Active fire zone (iii)Injection of water through borehole drilled up to seam in grid manner for extraction of heat and dilution

of CBG to diminish fire ball. (iv) Injection of high pressure nitrogen foam for reduction of oxygen within the area containing fire ball and (v) Periodic assessment of efficacy of the measures suggested by CSIR-CIMFR, Dhanbad, was decided by the competent authority to apply on experimental basis for retardation of fire in X seam at Bhuggatdih colliery to save important structures. The work is in progress.

Research Support Activities and Technical Services

1.1 Name of testing : Calibration of Anemometer, Velometer & Manometer.

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

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

1.4. 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 43 Anemometers were received and calibrated

1.5 This test is important for safety in mines.

2.1 Sponsoring Agency: M/S Ventilation Engineering, Kolkata, M/s Rohan Engineering Enterprises, Kolkata, M/S Annand Mincons, New Delhi and BCCL, Dhanbad

2.2 Quality control testing

2.3. Tests on one sample of Brattice cloth is carried out as per IS: 4355-1977 in respect of Air permeability test.

Tests on three samples of flexible ducting are carried out as per IS: 3768:1996

2.4. The test is important for safety in mines.

2.3 MINERS' HEALTH AND SAFETY

1. Study and Advice on Air Circulation and Other comfort/safety issues at Lord Jagannath temple Puri

One of the most sacred Hindu temple dedicated to Lord Jagannath, visited by millions of devotees everyday for offering puja. The temple is more than 900 years old and undergoing major repairing and structural consolidation work under the supervision of Archeological Survey of India (ASI). This project was undertaken on the request of ASI, Bhubaneswar Circle to seek technical advice for improving Air Circulation and Other comfort/safety issues faced by the visitors.

This is a joint study of CSIR-CIMFR and CSIR-CBRI with CIMFR part covering improvement of air circulation inside the temple and controlling dust generation during repairing work. A visit to temple site was made in January 2016 and set of measures were suggested for reducing dust generation and its control during the repairing work going on the temple. As the temple is very sacred and always crowded, it is open for inspection, observation etc during Rath Yatra period for air circulation improvement part of study in the temple.

2. Development of Chemical Oxygen type Self Rescuer (SCSR) of 30 minutes duration

The Project was taken up to provide technical support to M/s Sure Safety (India) Pvt. Ltd. Vadodara, for developing self contained self rescuers through industrial collaboration. SCSR is critical life saving personal protective equipment used by miners for escape during emergency. Since most of the manufacturer of the product is of foreign origin, successful implementation of this project will lead to development of an indigenous product which will boost Indian Industry, increase national self reliance and may reduce the cost of product through competition, thus giving impetus to make in India program of CSIR and Government of India.

During the year 2015-16, a prototype model has been made ready for its first stage evaluation at CIMFR laboratory.

3. Studies on determination of free silica (α quartz) content in Respirable Air Born Dust (ARD) in Coal Mines and preparation of data bank of free silica and other minerals present in dust as well as in coal" Grant-in -Aid Project

The Field study was completed in January 2015 but it took about full one year period of 2015-16 to compile the large scale data collected (1000 Coal and immediate rock samples and 2387 air borne respirable dust samples) during the project, its analysis and report preparation. Significant achievement of the study includes development of state of art laboratory equipped with XRD, FTIR, microbalance, for studying all aspect of respirable aerosol, development of Direct-on-filter analysis (DFA), a quick, non-destructive and reliable technique for quartz analysis in respirable dust collected on filter paper. All the coal seam has been classified into low, high and very high silica content which may be very useful information for taking preventive measures for ensuring healthier workplace environment in coal mines.

4. 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 67 SCSR samples of different make and model from various manufacturing industries and coal mines have been evaluated on artificial breathing simulator machine in laboratory condition. This includes 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.

2.3.I MINERS' SAFETY EQUIPMENT LABORATORY

Miners' Safety Equipment Laboratory is serving mining and allied industries by testing and certification of Fame safety lamp, LED miners' cap lamp, Safety wears and safety instruments. The cover rubber of conveyor belt is tested for mechanical properties as per Indian Standards for getting statutory approval. Calibration of Methanometer, Toximeter and Luxmeter is also carried out to make them fit for measurement of accurate concentration of methane, carbon monoxide and lumen respectively. Performance of newly developed gas measuring instruments is carried out to check their quality and its suitability in all types of mines.

1. Testing and Certification of Flame Safety Lamp

The flame safety lamp is used to detect methane content in underground mine workings on the basis of flame height and is capable to measure methane content between 0-5% by volume.

A total of six nos. of Flame Safety Lamp were tested as per IS:7577 -1986. All lamps were complied with the requirements given in the aforesaid Indian Standard. The test certificates were issued to M/s J. K. Dey and Sons, Kolkata.

2. Testing and certification of Miners' cap lamp

A total of twenty five nos. of LED Cap Lamps submitted by M/s Flameproof Udyogy Pvt. Ltd. Bilaspur; M/s Flameproof Equipment Pvt. Ltd., Mumbai and M/s Industrial Precision Products, Kolkata were tested for performance assessment as per International Electrotechnical Commission , IEC 690079-35-1&2 of 2011 and IS:5679-1986. These cap lamps have given more than 3000lux after 16 hours continuous switch on and complied with the requirement given in the IEC. Test certificates were issued to respective manufacturers.

The electric bulb is used in lead acid battery cap lamp as lamp, a total of 110 bulbs was tested as per IS:2596: 2004 and test certificates were issued to M/s S. G. Electro Chemical, Howrah and M/s Engel Industries, Kolkata.

3. Industrial Safety Wears

3.1 Industrial Safety Helmet

During the year, a total of thirty two nos. of industrial safety helmets were tested to check their qualities as per the IS: 2925-1984 with its amendment. All helmets conformed general requirements given clause No.5.0 of the IS: 2925-1984. Water absorption, shock absorption, penetration, flammability, heat and electric resistance tests were also carried out as per the above standards. Test certificates were issued to M/s Industrial Components, Kolkata; M/s Kamani Industries, New Delhi and the Chief Manager (mine), BCCL, Dhanbad

3.2 Safety Belt

The flammability of fifteen nos. of Safety belt was tested as per IS Code: IS: 3521 -1999. The Specimens were prepared and conditioned as mentioned in the Indian Standard. The test certificates were issued to M/s Safetech Redefining Safety, Kolkata; M/s R. V. Industries, Lucknow; M/s Super House Limited, Unao; and M/s Safewell Industries, Kolkata. The Safety belt of M/s Jeevan Industries, Mumbai; M/s Karam Industries Uttarakhand and Bureau of Indian Standard Eastern Regional Testing Centre, Kolkata were failed in flammability test.

4.0 Testing and Certification of Conveyor Belt

The strength of cover rubber of six nos. of conveyor belt was tested as per Indian Standard 15134 of 2002. Tensile strength, Elongation at break, Abrasion resistance and Hardness tests were carried out. The strength of N/N beltings of 1400mm and1800mm sizes and Steel cord belting of 1400mm size of Northern Coalfields Limited do not conform to the clause No.7.3 of IS 15143:2002. Test certificates were issued to the General Manager, Northern Coalfields Limited, Singaurli and M/s Phoenix Conveyor belt India (P) Limited, Kolkata.

5.0 Calibration of Methanometer and Lux meter

Two nos. of Luxmeter range 0-20000 lux submitted by Sr. Manager Sasti Colliery, Western Coalfield Limited, Nagpur and Central Coking Coal Limited, Bokaro, Jharkhand were calibrated. The calibration certificate was issued to respective applicants. Riken Methanometer measuring ranges 0-10% by volume of M/s IDL Explosive Limited, Gomia, Bokaro was calibrated.

6. Projects Completed during the year

6.1 Evaluation of Performance, Calibration and Technical Advice on Safety Equipment (Methanometer) of Satgram Area, ECL (SSP/22/2014-15) (H. Singh, and A. Barat)

In order to control hazards due to methane explosion in underground coal mines, methane content is monitored during operation either by Methanometer or Locally methane detector (LMD). More than two hundred Methanometer was calibrated for the year 2014-15. The work is completed.

6.2 Performance evaluation of Safety Equipments (Methanometer) of Kajora Area by calibration and advice on their performance (CNP/4053/2014-15) (H. Singh, and A. Barat)

At the request of the Area Safety Officer, Kajora Area, ECL, the performance of Methanometer 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 Methanometer found defectives during calibration were also repaired. Advice on working performance of Methanometer was reported to sponsor. The work is in progress.

6.3 Performance Evaluation of Altair 4X Multigas Detector and Advice on its suitability in all type of mines (SSP/64/2015-16) (H. Singh, and A. Barat)

The performance of Altair 4X Multigas detector was evaluated by simulated condition of underground mine working atmosphere. Heat and humidity are two main factors that affect underground mine environment. The general requirements, safety requirements and environment requirements as per the aforesaid Indian Standard were carried out for checking performance of the instrument. The Altair 4X multigas detector has been tested under environment requirements which have covered heat and humidity tests. The instrument has complied with all relevant clauses and is capable to measure four gases viz. methane (0-5%), carbon monoxide (0-2000PPM), Hydrogen Sulfide (0-200ppm) and oxygen (0-30%). The work is completed.

6.4 Performance Evaluation of Portable Methane Gas Detector , Model Telegas 1000AR (SSP/90/2015-16) (H. Singh, and A. Barat)

Two nos. of Methane Gas Detector model Telegas 1000AR has been submitted by M/s Teledyne-Ray, Kolkata for their Performance evaluation. The performance was checked as per Indian Standards: 13109 (Part 1 & 21) 1991 and 9937-1981. The instrument is capable to measure methane 0-100%LEL (0-5% by volume) and it has complied with all relevant clauses of the aforesaid Indian standards. The work is completed.

6.5 Performance Assessment and Calibration of Locally Methane Detector (LMD), Bhowrah Colliery, BCCL, Dhanbad.

Two nos. of LMDs of Bhowrah Colliery, BCCL was checked for their working performance and calibrated on quarterly basis for one year as per DGMS circular. It was observed that both the LMDs of the mine were working satisfactorily after service and calibration. The work is completed.

7. HRD services rendered:

A team of participants of Institute of Miner's 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 explained. Gas cap of flame safety lamp with percentage methane in explosive chamber were demonstrated.

3. MINE SUBSIDENCE AND SURVEYING DEPARTMENT

1. Stability evaluation of proposed merry-go-round alignment of Orissa Power Generation Corporation Limited over underground coal mine workings in Orient area of Mahanadi Coalfields Limited

The proposed MGR railway alignment runs over caved-out old workings, depillared panels as well as long standing coal pillars of HR Top, HR Bottom and IB seams of Mine no-3 & 4 of Orient area of Mahanadi Coalfields Limited (MCL). Shallowest depth of working panels was 30 m. Core-drilling of boreholes were carried out at three locations. Strata movement over old depillared panels and stability of underground workings by numerical modeling using FLAC-3D software below MGR alignment due to loaded rake movement were studied. As per records, the subsidence in Mine no. 4 has happened more than 20 years back in early seventies & nineties. No ground movement was observed over subsided ground and other depillared panels. The subsided area can be assumed to be settled by now & hence no ground movement apprehended in future. Stability evaluation of developed workings below proposed MGR alignment and dynamic loading analysis by numerical modeling depicted that standing on coal pillars may not be stable in long term. The area falling within 45° angle of draw from the offset of 5 m on both side of the proposed rail corridor are recommended to stow hydraulically with sand leaving minimum number of drivages for ventilation and man and material transport. The drivages should be staggered in all the seams and it should be adequately supported. Finally, MGR railway line can be made stable as recommended without altering the proposed alignment.

The project is completed.

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

Subsidence investigations were conducted over 9 stowed panels during April, 2014 to March, 2015 at Jamadoba 1&2 Pit, Jamadoba 6&7 Pit, Digwadih and Sijua collieries of Tata Steel in Jharia Coalfield for the safety evaluation of different surface features and structures. Geo-mining details and plans of different panels were collected. Layouts of monitoring stations with overlying workings and surface features were prepared for each panel. Construction of new monitoring stations over the new panels was done by the mine management. Subsidence monitoring was conducted quarterly over each panel.

All the panels were extracted by bord and pillar method of mining with 70-80 percent of coal extraction. Depillaring operations were carried out at depths varying from 83.50 m to 560.79 m. The width - depth ratio of the panel varied between 0.27 and 1.20, i.e., all the panels were under sub-critical width. All these panels were extracted under multi-seam mining condition with overlying old stowed and caved goaves. Extraction in two panels (2S/IX seam of Digwadih colliery and 10S/XI seam of Sijua colliery) were completed during the study period. The important surface features over most of the panels include company quarters, private roads, ponds, filter plant, tank, high tension lines and private buildings.

Maximum subsidence movement was 2.70% of extraction thicknesses over the 2S panel at Digwadih colliery. Maximum slope, compressive and tensile strains observed over measured panels were 4.0 mm/m, 1.02 mm/m and 1.03 mm/m respectively. Subsidence, slope and strains profiles were influenced by overlying old goaves, position of goaf edges, inclination of the seam,

topography of the surface profiles as well as left out stooks/ribs in the overlying seams worked by bord and pillar method of mining. Subsidence movements did not cause any adverse impact on surface features and structures.

3. Feasibility of extraction in 2-S panel of XI seam with hydraulic sand stowing at 1 & 2 Pits Jamadoba colliery of Tata Steel Limited

Geo-mining data of the proposed panel along with 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. Other relevant geo-mining parameters were also complied. Three dimensional modeling was carried out to predict subsidence, slope and strain using Influence Function Method. Subsidence contour and section of subsidence, slope and strain were prepared.

A few overlying panels i.e. E1, E2 of XVA seam and F panel of XIV seam were depillared in 1992 and 1996 respectively. Influence of these overlying panels was taken into consideration for prediction of subsidence, slope and strains due to extraction of 2-S panel of XI seam. Other overlying panels extracted prior to 1979 were assumed to have settled completely.

4. NATURAL RESOURCES AND ENVIRONMENT MANAGEMENT

4.1. ENVIRONMENTAL ASSESSMENT AND REMEDIATION

1.0 Study of Impact of Fly Ash Mine Filling on Flora, Fauna, Aquatic Lives and Habitat, Water and Air Quality Prior and During the Course of Ash Dumping in Mine

From the findings it was recommended that the discharge of mine water from Sarisatolli mines should be treated to remove hardness, dissolved solids, sulphate and manganese before discharge into Ajay River. This will help in flourishing the aquatic life in the downstream of Ajay River. The leachates obtained from fly ash and pond ash, at present doesn't show any harmful chemical in it but proper precautions should be taken and time to time pond ash should be characterized for any harmful component present in it.

2.0 Environmental Monitoring of different Clusters mines of Bharat Coking Coal Limited

Environmental monitoring of different clusters of BCCL mines was done as a part of environmental clearance compliance of coal mines by MoEFCC. PM10 & PM2.5 values were found to be high in most of the location in summer season both core and buffer mining zones. The surface water of the area is suitable for its designated use as a drinking water source with conventional treatment followed by disinfection.

3.0 Environmental monitoring in respect of ambient air, stack emission and effluents of Tenughat Thermal Power Station and Patratu Thermal Power Station

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

4.0 Technical Aid to Mining Industry by way of chemical analysis

Chemical characterisation of materials like lime stone dust, cable wire, wire rope, water & wastewater, oil and ore minerals were carried out for their characteristics evaluation.

5.0 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

The entire study area (watershed) of the project is 94.95 Sq. Km), the total surface water potential is estimated as 91.20 MCM/annum. After the implementation of Rain water harvesting structures in the study area, the total recharge potential is to be estimated 24.647 MCM/annum. By the implementation of rainwater harvesting in the study area there will be increase in ground water recharge potential of 0.857 MCM/annum.

6.0 Generation of Environmental Parameters, Critical Evaluation of Parameters, Preparation of EIA and Management Plan for Sijua, Bhelatand Colliery, Bhelatand coal washery, fireclay and magnetite mines in Latehar District, Jitpur colliery and Tasra Washery

The Sijua and Bhelatand Collieries have Main drainage as River Damodar. Concentration of PM2.5 and PM10 and Co well within the limit as the National Ambient Air Quality Standards (NAAQS). Environmental monitoring like air quality, water quality, noise level, soil quality and socio economic study has been carried out in and around Luti Murup Fire Clay Mine. Effective Environment Management Plan was prepared to minimize the negative impacts of the Project, if any, based on primary as well as secondary field data collected for various environmental components. Terms of reference (TOR) is cleared by Expert Appraisal Committee (EAC), Ministry of Environment and Forest (MoEF), New Delhi of Jitpur colliery and impact assessment is being carried out with respect to air, water and noise. The Tasra coal washery plant has certain levels of marginal impacts on the local environment. With effective implementation of proposed environmental management plan, these effects will be insignificant. Implementation of the project has beneficial impact in terms of providing direct and indirect employment opportunities. This will be a positive socio-economic development in the region.

7.0 Hydrology and Area Drainage Study of Gondavali Area, Madhya Pradesh

The monthly water balance study is that only 50% of available runoff results in stream flow and remaining 50% is detained by diversion and storage in bunded fields and as ground water storage. The present source of water is recharge from rainfall. The dynamic water zone is present in the depth range of 4.10 m to 6.30 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 (386.42 m) of the Nala and found 7.5 m above the HFL.

8.0 Evaluation of different Environmental Parameters like, Ambient Air Quality, Stack emission and Effluent Discharge at PTPS

Ambient air quality in and around PTPS shows that the level of PM2.5 and PM10 exceeds than their permissible limit of 60.00 and 100.00 µg/m^3 at two to three locations in winter months but the level of SO_2 and NO_2 remains under the threshold limit value of 80.00 µg/m^3. As far as its stack emissions results are concerned its units like unit # 4 of stack 1, unit # 6 of stack 2 do not work properly and level of particulate emission goes higher than 150 µg/m3 prescribed limit.

Noise level stands higher in Thermal Power Plant premises. Other areas are safe from noise pollution. Ash pond discharge show higher level of TSS ,TDS and COD. Soil quality of the area is not affected by Thermal Power Plant as dispersion of fly ash is minimum.

9.0 Study for evaluation of rain water harvesting Scheme at Turamdih Mine of UCIL, Jamshedpur, Jharkhand

Secondary data and ground water samples of surrounding area have been collected and analysed for pre monsoon and post monsoon season. Geomorphological study and hydrological study have been done. GIS map of the area have also been prepared. Other Study is in progress.

10. Evaluation of environmental parameters, compliance and related advice for Kathautia Open Cast Coal Mine, Daltonganj, Jharkhand

On the basis of the data generated it has been found that the environmental scenario in and around mining area of Kathautia Open Cast Mine with respect to air, water and noise are well within the permissible limits.

11. Study on Assessment of Groundwater Quality of National Capital Region, New Delhi Haryana Part, Phase-II

This project is supported by WAPCOS Limited, a Government of India Undertaking under Ministry of Water Resources, as a part of the Micro-level Hydro-geological Data Generation for the major project “Aquifer Mapping of National Capital Region of Delhi (NCR)”. The project involves collection and analysis of groundwater samples for major cations, major anions, heavy metals and other general parameters in the National Capital Region of Delhi (NCR), covering an area around 25,787 km^2 in parts of U.P., Haryana and Delhi states. In order to adjudge the groundwater quality of the NCR region, groundwater samples were collected from nine districts of Haryana sub-region of NCR. The groundwater samples were analyzed. The analytical results show that most of the ground water samples collected from Haryana sub region of National Capital Region (NCR) was not suitable for direct uses in drinking and domestic purposes with a few exceptions. The computed irrigation parameters showed that in general the groundwater of the NCR areas were good to permissible quality for agricultural uses. A detailed hydro-geochemical investigation and integrated water management is suggested for sustainable development of the water resources of the area for better plant growth as well as maintaining human health.

12. Study on Hydrological Parameters in National Capital Region (NCR)

The study involves carrying out of hydrological tests and estimation of hydrological parameters for characterization of aquifers in National Capital Region of Delhi. It is a part of the Aquifer Mapping of National Capital Region of Delhi (NCR) Project supported by WAPCOS Limited, New Delhi. Slug tests were conducted in the existing bore wells at 200 locations in the twenty three districts of Haryana, UP and NCT of National Capital Region (NCR) following the standard slug test procedures. The plot of depth to water level change (WL) Vs elapsed time (t) for different wells were plotted for estimation of hydrological parameters. The average hydraulic conductivity estimated to be varies from a minimum of 0.80 m/day to maximum of 6.83 m/day with an average K value of 3.22 m/day. The transmissivity (T) and storage coefficient (S) value estimated between 5.06 to 38.4 m^2/day (Avg. 13.84 m^2/day) and 11.17 $x10^{-9}$ and 3.84 $x10^{-3}$ respectively.

13. Soil Infiltration Study in National Capital Region, New Delhi

The project involves selection of suitable site for soil infiltration test on grid basis and to carry out the soil infiltration study at different sites in NCR districts, covering an area around 25,787 km^2 in parts of U.P., Haryana and Delhi states. The soil infiltration test has been carried out at 1000 locations in nine districts of Haryana, five districts of Uttar Pradesh and nine districts of National Capital Territory Delhi (NCT-Delhi). Double ring in filtrometer was used for measurement of infiltration rates at all the selected sites. Based on the field data, initial and final infiltration rate at different sites are estimated. Wide variation in the infiltration rate has been observed in the entire NCR region The average initial and final infiltration rate for the NCT - Delhi is found to be 237 mm/hr and 33 mm/hr respectively. The observed low basic infiltration rates at certain sites indicate poor percolation of excess water through sub-surface due to presence of hard pan and ultimately causing water logging problem in the area.

4.2. NATURAL RESOURCE AND MODELLING

1. Quality evaluation of stack emission, ambient air and effluent discharge of Tenughat Thermal Power Station with suggestive remedial measures.

Objectives:

(i) To evaluate the quality of flue gas emission from stack of Tenughat Thermal Power Station (TTPS), with respect to four major pollutants, namely, SPM, SO_2 , NOx and CO as well as measurement of Flue Gas Temperature, Exit Velocity and Flow Rate on monthly basis.

(ii) To evaluate the pollution load in and around Tenughat Thermal Power Station (TTPS) ambient air quality with respect to SPM, RPM, SO_2, NOx, CO and Pb on monthly basis.

Work done: There are two units but four paths adjacent to a long stack of height 220m and each of capacity 210 MW. Out-bye of the ESP of each unit is connected to the same stack. The sampling was done before Induced (ID) Fan adjacent to the duct connecting out-bye of the ESP to stack. The sampling was done once in every month and for a period of one year. Sampling was limited to running units because during every visit all the units were not running. Isokinetic condition of sampling was maintained at the time of sampling of the particulate matters. To get a true and representative sample, sampling was done only after the condition of the unit stabilized. Stack samples were collected as per running units during our visit.

Ambient air samples were collected from three locations, namely, Near DM Plant, Near GCR and Rooftop of Guest House on monthly basis. The competent authority of Tenughat Thermal Power Station (TTPS), has selected all the sampling locations of ambient air in and around TTPS.

Observation: From the investigations results, it was found that the lowest exit velocity of the flue gas was 15.6 m/sec. in the month of February'2016 at Path – A of unit-2 and highest was 19.0 m/sec in the month of July'2015 in Path - A of unit - 1. It was also seen that the maximum temperature of the flue gas obtained in the running units was 430ok in the month of March'2015 and July'2015 in Path - A of unit – 1 and minimum was 380ok in the month of February'2016 in Path - A of unit -2. Particulate matters measured minimum was 82 mg/Nm^3 in the month of November'2015 in Path-B of unit-2, whereas particulate matters measured maximum was 108 mg/Nm^3 in the month of March'2016 at Path – A of unit-1.

In the light of stack emission data, it might be concluded that the concentrations of particulate matters in the flue gas were well within the permissible limit of 150 mg/Nm^3 in almost all the paths of running unit but according to Ministyr of Environment, Forest and Climate Change Notification, New Delhi, the 7th December 2015 and gazette of India Extraordinary Published by Authority, New Delhi, Notification Regd.No. D.L.-33004/99 Tuesday the 8th December'2015, its permissible limit has been reduced from 150 mg/Nm^3 to 100 mg/Nm^3 Particulate matters measured maximum was 108 mg/Nm^3, which is significant higher than its latest limit. Also concluded that the concentrations of SPM, RPM, SO_2, NOx, CO and Pb were well within the permissible limit in the ambient air in and around the Tenughat Thermal Power Station, because the height of the stack is 220 meters as well as light plume discharged to the atmosphere.

Conclusion: In the light of investigational output, it has been inferred that Tenughat Thermal Power Station, Lalpania has made all efforts to reduce the pollution load and discharged fewer pollutants in the atmosphere. Suggestive remedial measures have been recommended for the efficient performance of the ESP and its ambient air pollution for the clean atmosphere.

Recommendation:

(a) Regular and adequate maintenance is required in all the paths of running units for efficient functioning of the ESP's.

(b) Regular water spraying is needed for dust suppression on the transport road inside the plant premises as well as at the coal handling plant site at the time of dumping.

(c) Semi-circular water sprinkler system should be used at an alternate position on both the sides of coal transport road and dump yard to reduce the ambient air pollution and for the clean atmosphere of the surrounding areas.

(d) The system of wet ash collection may be replaced dry ash collection system.

This will help in utilizing fly ash in many more ways.

2. Environmental monitoring of mines/washires for clusters VII, VIII and IX of BCCL as per the requirement of environmental acts, laws, environmental clearance conditions, etc. and advice thereof.

This project was sponsored by BCCL Following are the Ambient air monitoring locations where monitoring have been carried out : Namely, Moonidih washery, Project Office Hurriladih, North Bhowra workshop , Project Office Jeenagora, Project OfficeDobari, Dhansar project Office under Kusunda opencastproject Area and Kusmatand Village.

Several Samples of SO_2 and NOx have been analysed in the laboratory, guided to its Project Assistants for the calculations of SO_2 , NO_x , PM_{10} & $PM_{2.5}$ and checked its results.

3. Carrying capacity study of Saranda forest in West Singhbhum District Jharkhand :to suggest the permissible ore production for sustainable development of the region.

Several Samples of SO_2 and NO_x have been analysed in the laboratory, guided to its Project Assistants for the calculations of SO_2 , NO_x , PM_{10} & $PM_{2.5}$ and checked its results.

4. Environmental Monitoring of Mines / Wahseries of BCCL, 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 XVI & XVII clusters of mines of BCCL. Air quality assessment has been made by deploying PM10 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 have aggravated pollution level in BCCL mines. It can be concluded that concentration of pollution were well within the limit.

5. EIA study and preparation of EIA/EMP of Chasnalla, Jitpur in district Dhanbad, Jharkhand and Ramnagaram in Burdwan, West Bengal, Collieries of SAIL, Fireclay and Magnetite mines in Latehar, Jharkhand

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.

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

The Pilot plant made under this project was successfully installed, commissioned and demonstrated, which was finally handed over to the funding agency, i.e., Dhanbad District Administration (Zila Parishad, Dhanbad) in September, 2015 for future maintenance, operation and utilization.

7. CSIR-800/TECHVIL Program

This is a national mission program launched by CSIR, New Delhi. Every lab has to select some site to demonstrate all the technologies related to rural development along with the linkage with bank and marketing in order to achieve sustainable livelihood which will help in checking migration from the rural areas.

CSIR-CIMFR, Dhanbad has selected Ratanpur panchyat under this program where already Sansad Adarsh Gram Yoazna (SAGY) has been in progress. Our Institute conducted water and soil sampling with analysing in order to formulate plan for sustainable agricultural development along with utilization of available natural resources up to optimal level for the development of that area.

8. "Investigation on Environmental Impact due to control blasting in and around the limestone mining of ASI (K) Ltd Ramganjmundi, Kota (Rajasthan) with a special focus on the receptors including civil structures and ambient air quality using modeling and simulation" Associated Stone (Kudayla) Industries [ASI(K)], Kudayla Industrial Area, Ramganjmandi, Kota, Rajasthan

Under this project effect of blasting studies has been carried out on the ambient air quality, civil structures, human habitat, vegetation, flora and fauna and overall environment in winter season. Several blast were carried in different time period and distance from mine and with different combination of blasting material and methods of blasting.

5. ROCK SLOPE

The major research areas of the department were optimum design of active and final mine slopes along with dump slope design for productivity improvement; control & mitigation measures for safety and stability of opencast coal and non-coal mines.

Seven numbers of openpit mine slopes were designed during 2015-16. It includes the design of 420 m deep Rampura Agucha Lead Zinc mine, HZL, with present depth of 360m. It would be the deepest opencast mine in India. The optimum mine slope design has advantageously helped in recommendation of steeper slope angles for different opencast mines that has helped to improve the economy of the industry. The designs helped to save crores of rupees, by avoiding extra overburden removal, at the same time ensured the safety of men and machines working at the site. The mine companies where the study was conducted are M/s ACC Ltd., M/s HZL, NMDC, RSMML, Binani Cement and SECL.

Two overburden dumps were designed to ensure the minimum land acquisition for the development of higher external dumps and to get the steeper internal dumps without compromising the safety and to accommodate the maximum overburden dump material. The study was conducted for M/s NCL and SECL.

Post failure study of opencast mine was conducted to understand the possible reasons of failure to check the recurrences of slides ensuring the safety of men and machines at quarry-2 Talangi chromite mine, Odisha, M/s IFCAL.

The stability conditions of the mines were evaluated at regular interval to understand the stability conditions at different phases of the mining. It was also aimed to predict the slope instability for the safety of men and material working at depth at pit bottom. It was conducted for M/s IMFA, Tata Steel, RSMML, HZL, M/s Balasore Alloys Ltd and HCL.

6. FLAMEPROOF AND EQUIPMENT SAFETY

01. Assessment and Advice for suitability of Electrical equipment installed in Zone 1 & 2 hazardous areas of Ravva Oil and Gas field in PKGM-1 offshore block, located in Krishna-Godavari Basin, Bay of Bengal off the coast of Andhra Pradesh as per different relevant standards.

M/s. Cairn India Limited, Gurgaon offered different certified and approved flameproof, intrinsic safety and increased safety electrical equipment for their suitability to use in hazardous explosive atmosphere. Based upon the physical assessment and visual inspections of different certified electrical equipment to maintain the integrity of their type of protection as flameproof /increased safety/ intrinsic safety, the installed equipment are found suitable for safe use in Gas Gr. IIA/ IIB and Zone 1 and Zone 2 hazardous atmospheres only of Ravva Oil and Gas field n PKG-1 offshore block.

02. 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 858KW, 6Pole, 600V in Frame Size OIM5101AZ as per IEC: 60079-7:2006 and IEC: 60079-15:2005 for use in Zone-2 Explosive atmosphere.

M/s. BHEL, Bhopal offered One no. aforesaid squirrel cage induction motor along with design drawings and necessary assessment of electrical safety parameters and advice at their shop. On the basis of assessment of electrical safety parameters and advice as per IS/IEC 60079-7:2006 and IS/IEC 60079-15:2005, the motor under reference confirms to the applicable requirements of type of protection Ex ‘e’ and Ex ‘n’ respectively for use in Zone-2 hazardous area as defined in IS: 5572. The stator winding temperature rise is determined and found well below that of the insulation class ‘B’. However, the class of insulation of the stator winding is above class-H.

The room temperature in locked rotor condition is calculated as per Equation -3 and is limited to temperature class T3 at an ambient temperature of max. 45°C and the time t_E for aforesaid motor is 31.91 sec. Therefore, the safe time t_E to switch off the motor under abnormal or locked rotor condition is before/within 31.91sec.

03. Assessment and Advice for suitability of Electrical equipment installed at hazardous areas of Central Region 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 to maintain the integrity of their type of protection as flameproof/intrinsically safe/increased safety, the installed equipment are suitable for safe use in Gas Gr. IIA/IIB and Zone 1 and Zone 2 hazardous atmospheres of Central Region of (Tripur and CBM-MBA) of ONGC asset.

7. MINING METHODS SECTION

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

Accomplishments as per the Proposed Action Plan of the project:

In order to address the issues of coal extraction from ground control as well as spontaneous heating points of view, a scientific study is being continued to delineate the factors/parameters influencing the extraction of thick coal seams. Field and laboratory investigation as well as extensive numerical modelling using FLAC3D and CFD modelling are in process. The tandem approach as detailed in the quarterly reports is to be practiced as a demonstrative trial for extraction of low-incubation coal seams like R-VI seam having 5.4m thickness in the sub-panel B-2A.

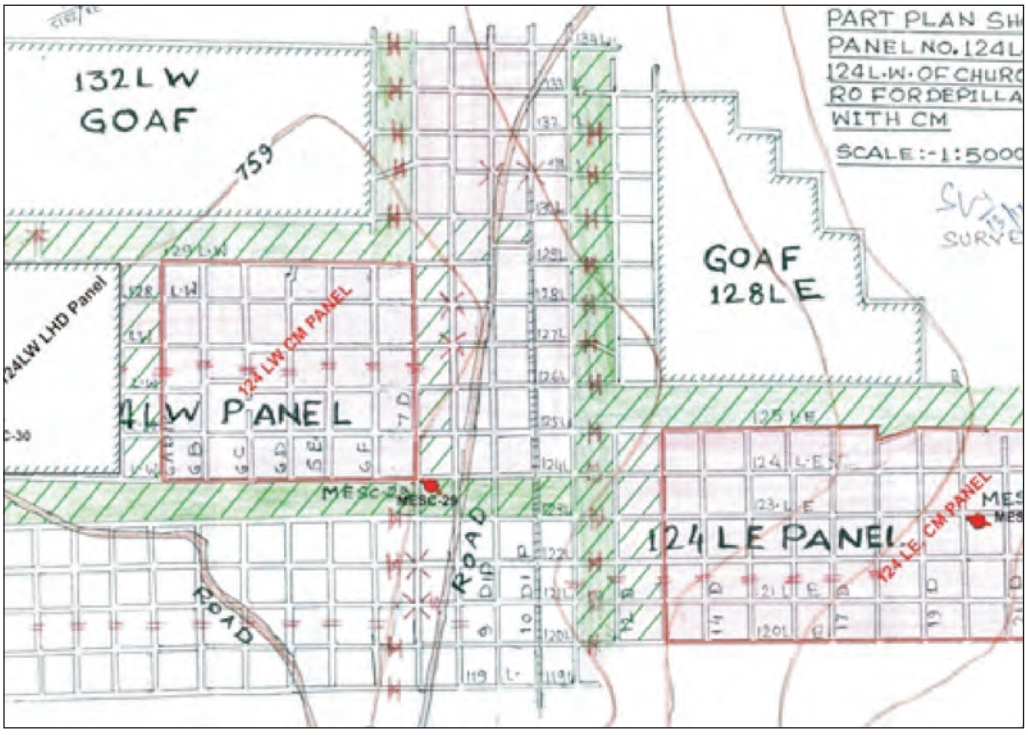
2. Evaluation of roof rock behavior for depillaring T9 panel at Tandsi 3&4 Incline, Kanhan Area, Western Coalfields Limited

This scientific study presents results and analysis of the strata movement monitoring during extraction of T9 panel using a suite of geo-technical instruments along with recommendations for safety of future such depillaring with CM deployment.

3. Scientific study for strata evaluation study including convergence load on support with a suite of geotechnical instruments in 124LW CM panel at Churcha RO Mine, SECL

CSIR-CIMFR was entrusted to conduct strata evaluation and management study during depillaring of the CM panel of 124LW not only to validate the recommendations of the earlier conducted study, but also to assess strata movement during depillaring with respect to safety and conservation. CSIR-CIMFR provided a scheme of instrumentation plan to monitor the movement of strata with different types of geo-technical instruments during depillaring of the CM panel. Thus, strata movement observations as well as roof falls were monitored and recorded during the depillaring operation in the panel. The depillaring operation in the CM panel of 124LW was started in November, 2015 and was successfully liquidated by August 2016. To give a boost to the production programme, Continuous Miner Technology with remote operation mode in

conjunction with goaf edge induced blasting has been found to be a viable option for liquidating standing pillars of coal in underground mines at a faster rate beneath Dolerite sill in Churcha RO mine. However, it may be recommended to implement the rib system of mining like Wongawalli method, established world over.



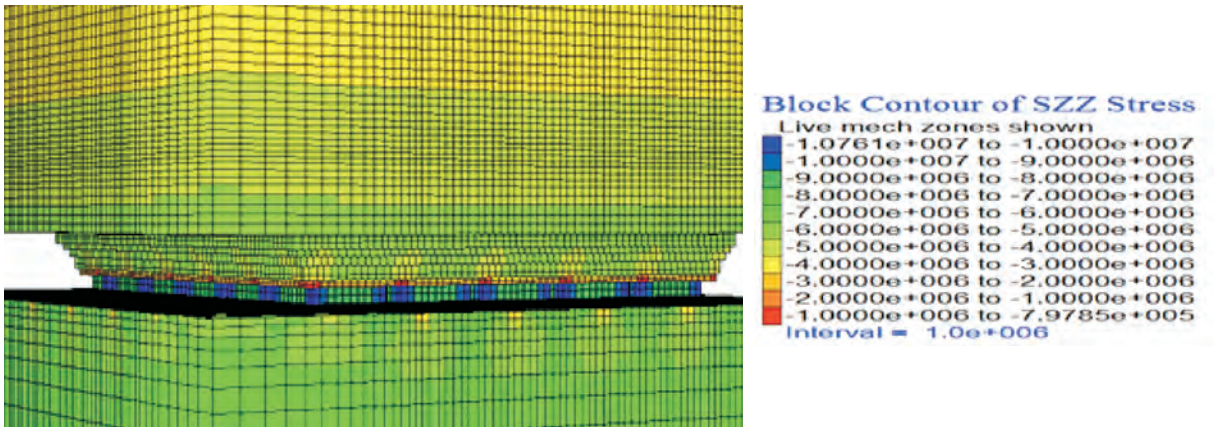
Part plan showing the workings of Seam-V in 124LW CM panel and 124LE CM panel and other adjacent panels

4. Scientific study for strata behaviour evaluation and strata management in 124LE panel of East Block of Churcha (RO) mine with Continuous Miner deployment

Strata management using suite of geotechnical instruments resulted in successful and safe extraction of Seam V below dolerite sill by caving method using CM. From the experiences gained during pillar extraction, goaf edge induced blasting at 4-way and split junctions should be done as and when necessary for smooth depillaring. However, it may be recommended to implement the rib system of mining like Wongawalli method, established world over.

5. Scientific study to assess cavability of massive deccan trap roof formation and to design method of working in seam I at Maori incline, Mohan colliery of Kanhan area, WCL

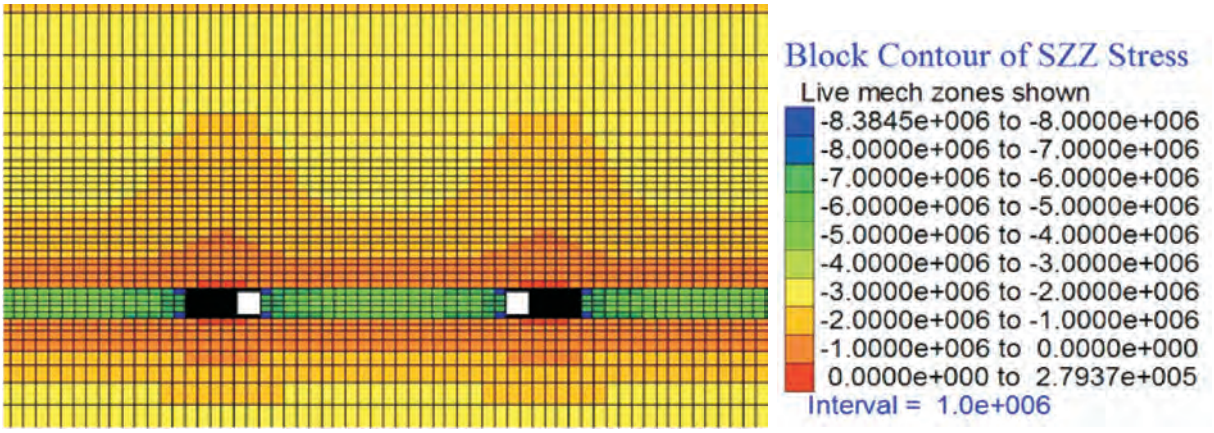
In this scientific study a method of extraction of coal was suggested for 6m thick Seam-I beneath Deccan trap consisting of non cavable massive basalt rock formation. A stress-isolating corridor of 2 pillars width was recommended to segregate the proposed workings from the adverse effect of standing roof of depillared workings. Stability assessment of the barrier pillars and suggestions to reinforcement in terms of the side-supports for better stability of over stressed pillars have also been included.



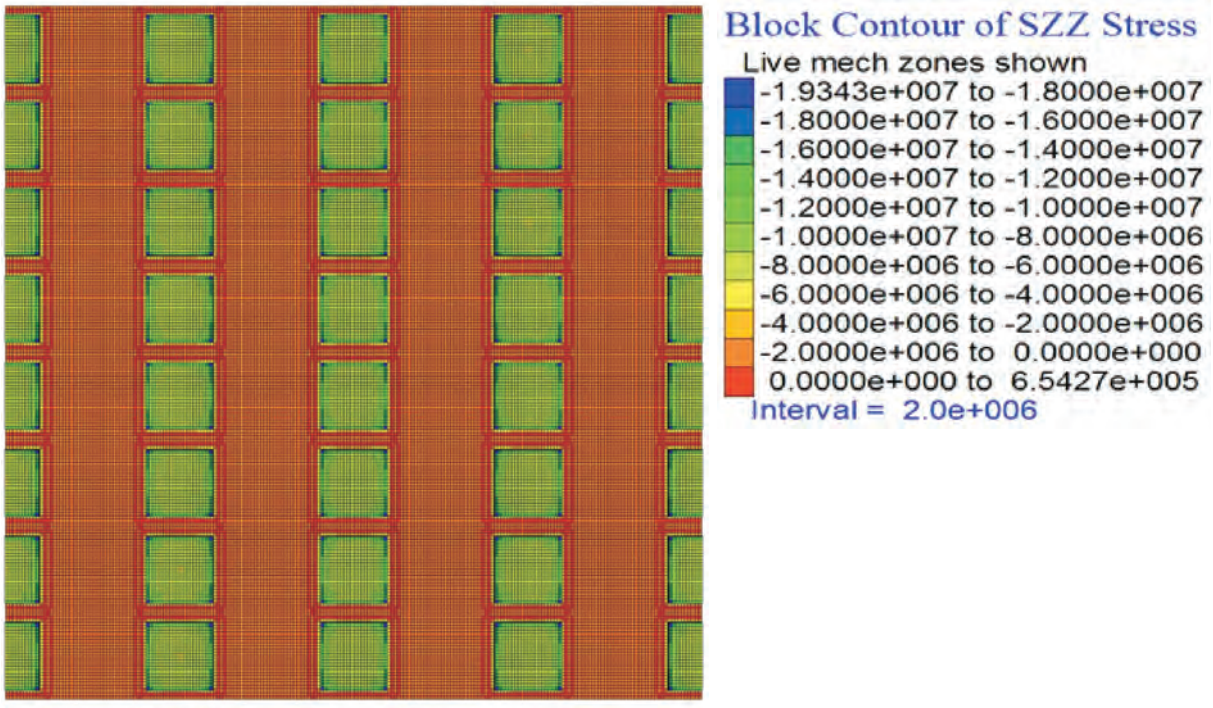
Stress redistribution with hanging goaf

6. Advice on feasible development and depillaring of coal seams in total perspectives with an aim to have no adverse impact due to mining subsidence on surface at Lohapatti colliery, West Jharia Area, BCCL

Keeping in view of the technical, economical and managerial constraints at Lohapatti colliery, feasible partial extraction methods are suggested for depillaring XIV (the top seam), underlying XIII and XII with no adverse effect due to mining induced subsidence and tensile strain on the surface.



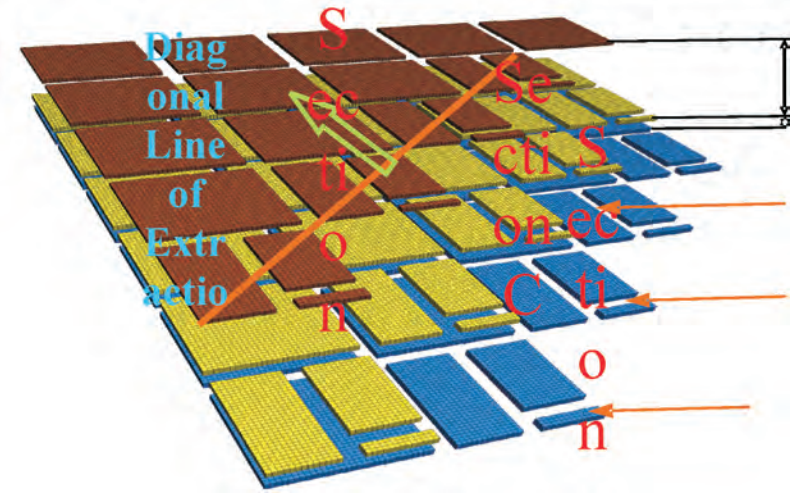
Block contour of Szz stress of modeled panel 2 of XIV seam, pillar size 25m x 25m (centre to centre) during development



Block contour of Szz stress of modeled panel 2 of XIV seam, pillar size 25m x 25m (centre to centre) during depillaring

7. Advice on Methods of Working and Sequence of Extraction of Existing Coal Reserves at Hirakhand Bundia Mine, MCL

In this scientific study, suitable method of development in virgin patch along with support design and extraction of 30m thick Hingir Rampur seam contiguously developed in five sections below Samaleswari OCP overburden dump are given. Stability of parting among the sections of the seam has also been assessed. Analysis has been carried by field investigation and numerical modelling.



Diagonal line of extraction of three sections where top section is kept one pillar ahead of bottom section.

8. Scientific study for caving behavior of Adriyala LW Panel No. 1 of Adriyala project Area, SCCL by installing the peizometer for continuous monitoring at Adriyala LW Panel, SCCL (Part B

In this study, hydro-geological study will be done by

- Investigation on source sustainability study of water requirement and water balance and long term expected impact assessment on water regime.
- Quality assessment of ground water viz. TDS, Turbidity, pH, Temperature, DO, Salinity, Conductivity etc.
- Determination of aquifer parameters
- Installation of peizometer (at suitably selected site) for ground water monitoring through Auto DWLR

9. 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

Methods of liquidation of developed pillars with caving in the proposed CM panels in R-VII seam (Bankola Seam) along with support design are designed, ensuring no subsidence damage to the floor of R-IX(T) [Kajora seam] and also on surface (Ukhra village).

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

Determination of pre-excavation stresses and orientation of the development galleries accordingly may not provide a solution in Thesgora due to high value and general nature of perturbation. From the results of numerical modeling, it is found that, the underground proposition for development and depillaring in all three workable seams at Thesgora mine is not feasible and therefore not recommended, for future such propositions. 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.

11. Advice on Design of Development Workings and Support System in 4A Seam with Continuous Miner Deployment at Haldibari Underground Mine of M/s SECL

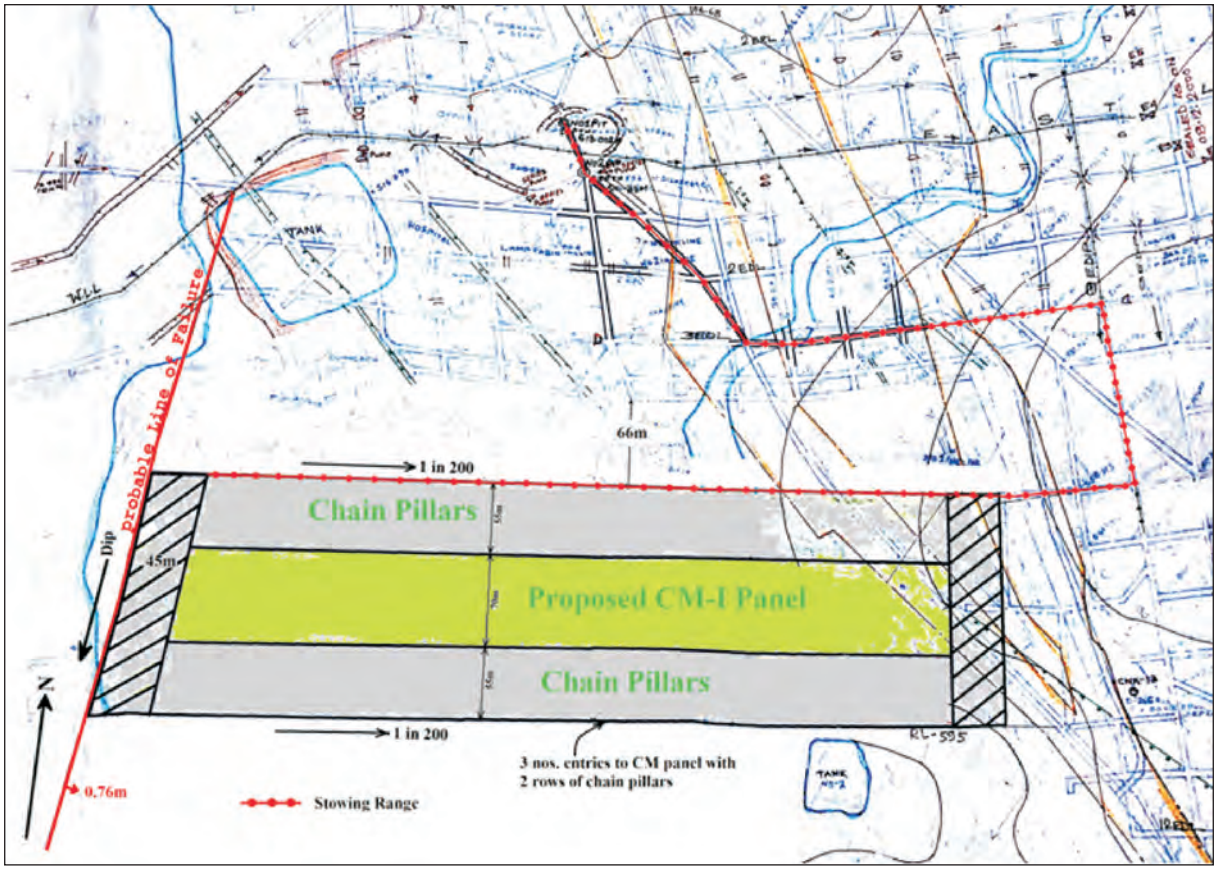
A study is undertaken by CSIR-CIMFR, Dhanbad as per the request of JMS Mining Services Pvt. Ltd., Kolkata to provide advice on development of Haldibari Underground Mine for introduction of Continuous Miner Technology for development of 4A seam. Depth of cover of the area under study is varying from 41 to 213m with an average of 170m. Based on field investigations, empirical formulations and numerical modelling exercises, it was recommended that:

- Pillars should be developed with gallery width not more than 6.0m in 4A seam. The pillar dimension recommended should be (a) not less than 26m x 26m [centre to centre (c-to-c)] for depth of cover 100m or less; (b) not less than 36m x 36m (c-to-c) for depth of cover 100-170m and (c) not less than 38m x 38m (c-to-c) for depth of cover > 170m. The maximum height of the gallery is prescribed hereby as 4.0m and 4.5m (or the seam thickness, whichever is less), up to 100m and for depth of cover more than 100m respectively.

- The pillars of recommended dimensions, so formed, have a factor of safety of 2.0 or more.
- All the developed galleries are to be supported with full column resin grouted roof bolts (1.8m grouted length) at an interval not more than 1.5m between two bolts in a row and not more than 1.2m between two consecutive rows of bolts. All (6m x 6m) junctions formed are to be supported with additional 9 numbers of bolts with at least 1.0m interval in between rows of bolts as well as two bolts in a row. It is to be noted that the spacing between the bolts in a row and spacing between two rows of roof bolts may be modified subject to SEPT determination in seam 4A at Haldibari Underground Mine. The grouted length may be increased to 2.4m or so depending on instrumentation results and their analysis.

12. Advice for an innovative method of coal extraction in Dishergarh seam (R-IV) at Chinakuri Mine No. 1, ECL

A comprehensive research study was undertaken to find out a feasible method of coal extraction with CM deployment in conjunction with stowing, being an innovative effort proposed to be implemented at the mine, in a prioritized R&D trial panel. Wongawilli method of mining with caving, established world over, need to be modified with a matching stowing scheme and then, it may be a feasible method of coal extraction with CM deployment in R-IV seam of Chinakuri Mine no. 1.



13. Advice on caving characteristics and ground movement behaviour in 124LW panel with Continuous Miner deployment at Churcha RO mine, SECL

This scientific study is primarily to understand and assess in the perspective of coal extraction following the straight line of extraction with CM deployment:

- Caving behavior of roof of seam V at Churcha RO mine and
- Ground movement behavior, including coal movement from the side of the barrier/ developed pillars vis-à-vis extraction geometry made against The position of goaf edge movements at actual site-conditions.

8. MINE DESIGN & SIMULATION SECTION

1.0 Design of methodology for safe development & depillaring of No. 3 seam in 46 D district above stowed goaf of No. 4 seam & stability assessment of no. 3 seam galleries and partition between No. 3 & No. 4 seams at GDK-10 Incline of Adriyala Projects area, SCCL

At GDK-10 incline, Adriyala projects area of SCCL, scientific study was conducted for design of development and depillaring of No.3 seam in 46D district above the stowed goaf. Suitable methodology was given based on numerical modeling and field study .

2.0 Scientific study for development & depillaring of the virgin properties of No. 3 and 4 seams of GDK No. 1 & 3 Incline under Jangaon tank at RG-1 area of SCCL

At GDK No.1 & 3 incline under Jangaon tank of RG-I area of SCCL, scientific study was conducted for development and depillaring of the virgin properties of no.3 and no 4 seams based on numerical modeling and field study. A suitable design of development and depillaring methology for both seams have been recommended.

3.0 Scientific analysis and advice regarding Roof rock behavior of seam I & II development working using low height continuous Miner at Rani Atari u/g mine, Chirimiri Area, SECL

At Rani Atari u/g mine, Chirimiri area of SECL, development was going on in seam I and II by low height continuous miner. Strata monitoring investigation were conducted and necessary advice was given regarding stability of development workings.

4.0 Design of method extraction in panel No. 11/1 (S) in 11 seam with controlled effect on the floor of overlying waterlogged seams at Bhelatand (A) Colliery, Tata Steel.

At Bhelatand (A) colliery, Tata Steel, a scientific study was conducted to design a suitable of method of extraction in panel No.11/1 (S) in 11 seam to control subsidence effect on the floor of overlying waterlogged seams . Based on field data analysis & numerical modelling, a suitable design of panel extraction methodology was recommended.

5.0 Scientific study for monitoring the subsidence of different strata lying below Dhanbad-Chandrapura Railway line over X seam fire affected area at GopalGareria section of Sendra-Bansjora Colliery, BCCL.

At Sendra Bansjora colliery, Sijua area, 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 Necessary advice was given time to time based on monitoring study.

6.0 Assessment and advise on "Strata behavior during extraction of developed pillars in CMP-7A, 7B/1 and 7B/2 panels using CM Technology at VK 7 Incline, SCCL"

At VK7 incline in Kothagudem area of SCCL, strata monitoring investigation were conducted for CMP-7A, 7B/1 and 7B/2 panels in King seam . Based on field monitoring study necessary advice was rendered during its successful extraction by CM.

7.0 Assessment and Advice on Strata Monitoring of Blasting Gallery Panel, BG-10 in Queen Seam at 21 Incline Mine, Yellandu Area, SCCL

At 21 incline mine, Yellandu area, SCCL a strata monitoring investigation were conducted and necessary advice was rendered during successful extraction of thick seam by Blasting Gallery method in panel BG-10 in Queen seam.

8.0 Scientific study for feasibility extraction of development pillars in CMP-8 panel in King seam below caved LW panels of Top seam at VK-7 Incline, SCCL

At VK7 incline mine, Kothagudem area of SCCL, a scientific study was conducted for suitable extraction pattern of developed pillars along with support system for CMP-8 panel in King seam using Continuous miner technology. Scientific study was conducted and suitable extraction pattern and support system was recommended to implement in the panel.

9.0 Scientific study for designing extraction in proposed panel No. BG-S and U in Queen seam at 21 Incline, Yellendu area, SCCL

At 21 incline mine, Yellandu area, SCCL, a scientific study was conducted using numerical modeling technique and field data. A suitable method of depillaring was given for the extraction of BG-S and U panel in Queen seam by Blasting Gallery method.

10.0 Design of extraction pattern for developed pillars of panel CMP-9 [panel CMP 9A(1) and CMP 9A (2)] in king seam lying below caved goaf of top Seam using CM Technology at VK -7 Incline SCCL

At VK7 incline mine, Kothagudem area of SCCL, scientific study was conducted for design of suitable extraction pattern of developed pillars along with support system for CMP-9 panel[Sub panels CMP 9A(1) and CMP 9A(2) in King seam. Based on numerical modeling and field investigations, suitable pattern of extraction of developed pillars was recommended.

11.0 "Ground Control Management Plan" of Rampur Agucha Mines of M/s Hindustan Zinc Limited, Rajasthan

At Rampura Agucha u/g mine below open pit after leaving proper size crown pillar stopping method of extraction with CRF/RF was recommended. In this project support design for different levels of underground workings have been designed for "Ground Control Management Plan" Auditing of the same was done at least 4 times in a year. Suggested modified support patterns if required.

12.0 To carry out scientific studies for geotechnical monitoring of u/g workings stability For Rampur Agucha Mines of M/s Hindustan Zinc Limited, Rajasthan

Geotechnical monitoring of underground working stability of Rampura Agucha mine M/s HZL was

carried out for one year. Based on monitoring result of different instrument readings, necessary suggestion was made for safe ore extraction.

13.0 Development of suitable design methodology for extraction of coal at depth (>300m) for Indian Geomining condition (DEEP COAL), CIMFR Proj No. 303 Task No. 5.2:- Numerical Simulation of coal pillar extraction using CM technology for deep coal

It is a part of 12th Five Year Plan CSIR Network Project. Field Study and Numerical modelling of VK7 underground mines having depth of cover > 350m have been designed for depillaring of developed pillars using CM technology. Extraction and monitoring of the designed panel is under progress. Similarly, design of development and depillaring for virgin patches with CM technology for Shantikhani mine has been completed where depth is > 350m. It is expected that it will be implemented soon.

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

Mine management of Bhowra (N) requested CSIR-CIMFR for a scientific study for feasibility of extraction of pillars in contiguous V and VI seam of 23/8 Incline with hydraulic sand stowing. Based on numerical modelling study & the prediction of subsidence, slope, compressive and tensile strains for safe mining, a suitable method of extraction was recommended.

15.0 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

Mine management of Sawang Colliery of M/s CCL requested 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. A suitable methodology of extraction is recommended for semi-mechanised extraction of the seam with SDL.

16.0 Development of a Technology for Optimal Extraction of Locked-up Coal from Underground Mines using Artificial Pillars, Acronym: DeCoalArt), Task Title: Numerical modelling and stability analysis, method of work, laboratory scale demonstration

It is a 12th Five Year Plan CSIR Network Project. Based on numerical modelling, number of extraction methodologies are designed and analysed, and a suitable extraction methodology is selected for detailed analysis. The methodology is studied through modelling for assessing the stability of surrounding rock mass and artificial pillars to be erected for use in underground coal mines for coal extraction. The laboratory scale demonstration of the project is under progress.

17.0 Development of a system for early detection of fire including real time monitoring of fire associated gases

It is a 12th Five Year Plan CSIR Network Project. Proximate analysis of coal samples collected from fiery seams of different underground coal mines has been completed. Lab scale model of remote monitoring device for underground coal mine gases has been developed. Development of remote monitoring device for underground coal mine gases using roof based traction system is being developed. Design of wireless sensor networking integrating the sensors for the fire impending parameters is under progress.

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

This project is being jointly carried with CSIR-CMERI, Durgapur. Design of compatible wireless module for vibrating wire based geotechnical sensors such as stress meter has been completed and laboratory trial and fine tuning is being carried out. In addition, a laboratory scale wireless sensor network (WSN) has been developed for transmission of the sensed data from the various potentiometer and thermistor based sensors. Efforts are being made for PCB design and intrinsically safe certification.

9. STRATA MECHANICS AND NON CONVENTIONAL GASES

9.1 STRATA MECHANICS

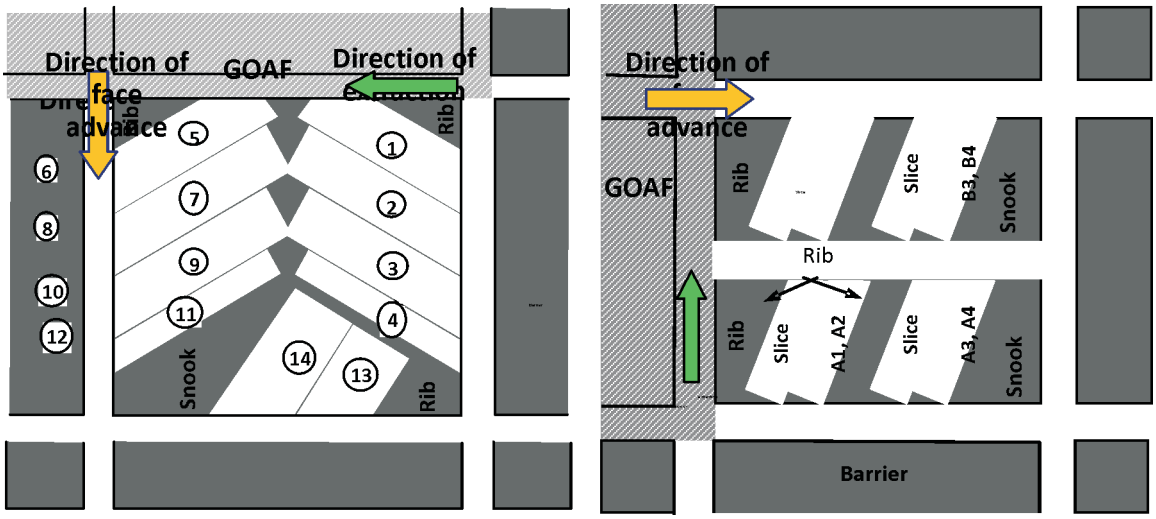
This department attempted to use the basic rock mechanics principles to improvement in efficiency and safety of underground coal mining, mainly mechanised depillaring and thick seam mining, during the period April 2015 to March 2016. In this period, the department undertook various industry sponsored and in-house assignments related to the design of underground mining structures on the basis of extensive field and laboratory investigations.

For efficient depillaring of a thick and developed (along floor) coal seam, it is observed to be safe and productive to extract total thickness of the seam in single lift. Cable bolting based depillaring of total thickness of a thick (7 to 8m) coal seam in single lift is found to be effective under the prevailing geo-mining conditions of the Indian coal fields. Conducting some basic field and laboratory studies through procured core samples of coal and overlying strata, cable bolting based depillaring of total thickness in single lift is designed and practiced for nearly 7.0 m thick Kajora Top coal seam at Madhusudanpur 7 Pit and Incline mine and Lower Kajora seam of nearly same thickness, in the leasehold area of Central Kajora colliery. Performance evaluation of this method by field instrumentation and monitoring did not notice any major strata control problem. Full column grouted cable bolts provided effective support for the overlying coal band in the roadways and also improved stability of the overhanging beam/cantilever of the stone roof strata for safe withdrawal of the blasted roof coal band during retreat. Results of field monitoring validated the adopted design for the site and did not show any major dynamic loading phenomenon during caving of the roof strata. Observed influence of the caving remained limited to 30 m distance from the goaf line. Shallow depth of cover and presence of weak and laminated roof strata at the site are also found to be helpful in alleviating the chance of pillar/ stook instability due to increased height of extraction.

Different investigations were carried out to design manner of extraction, support system, caveability Index, rib/snook area, density of roof bolt based breaker-line support etc. in Continuous Miner based mechanised depillaring operations. Laboratory studies for these elements were carried out on simulated models (mainly using Flac 2D & 3D), where input parameters were collected from field and testing of samples in the laboratory. Field performance studies of all these elements of mechanised depillaring were also conducted for further improvement in the design. Considering the site conditions of Indian coal mines, it is found that the area based approach for rib is, relatively, more suitable in mechanised depillaring of the existing pillars. Positional effect of the mining induced stress also needs to be considered for the placement of roof bolt based breaker-line support in a mechanised depillaring operation. An attempt of partial extraction

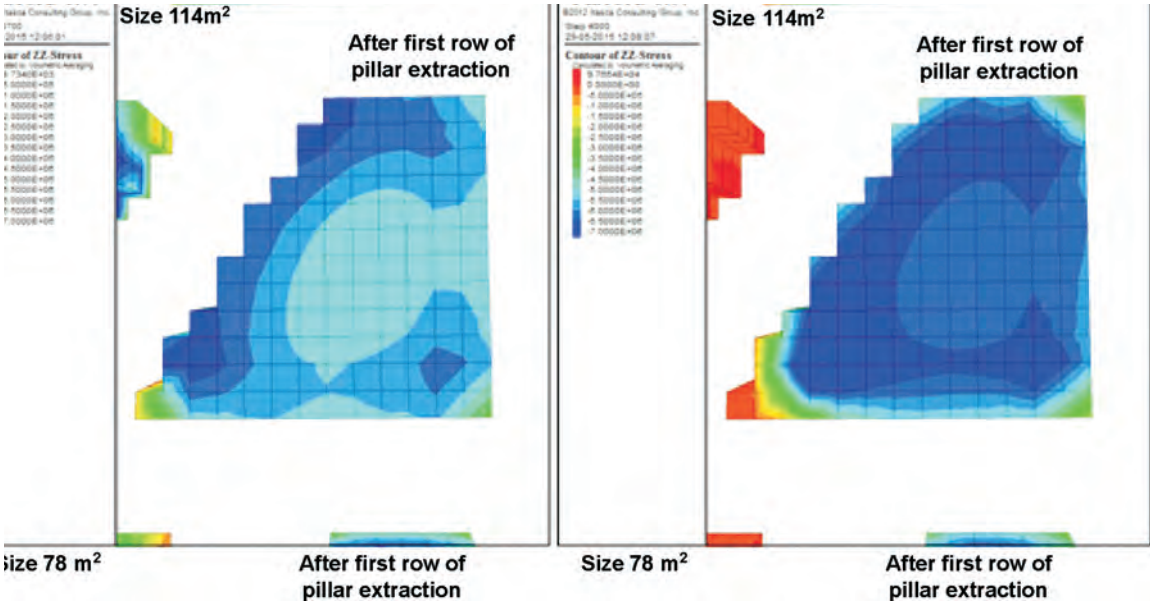
under competent roof strata should not be attempted at higher depth (>300m). Also, it is found to be difficult to go for total depillaring at higher depth of cover under weak and laminated roof strata. These studies were done for safe and efficient extraction of developed coal seams at GDK-11 Incline Mine of SCCL and Pinoura Mine of SECL.

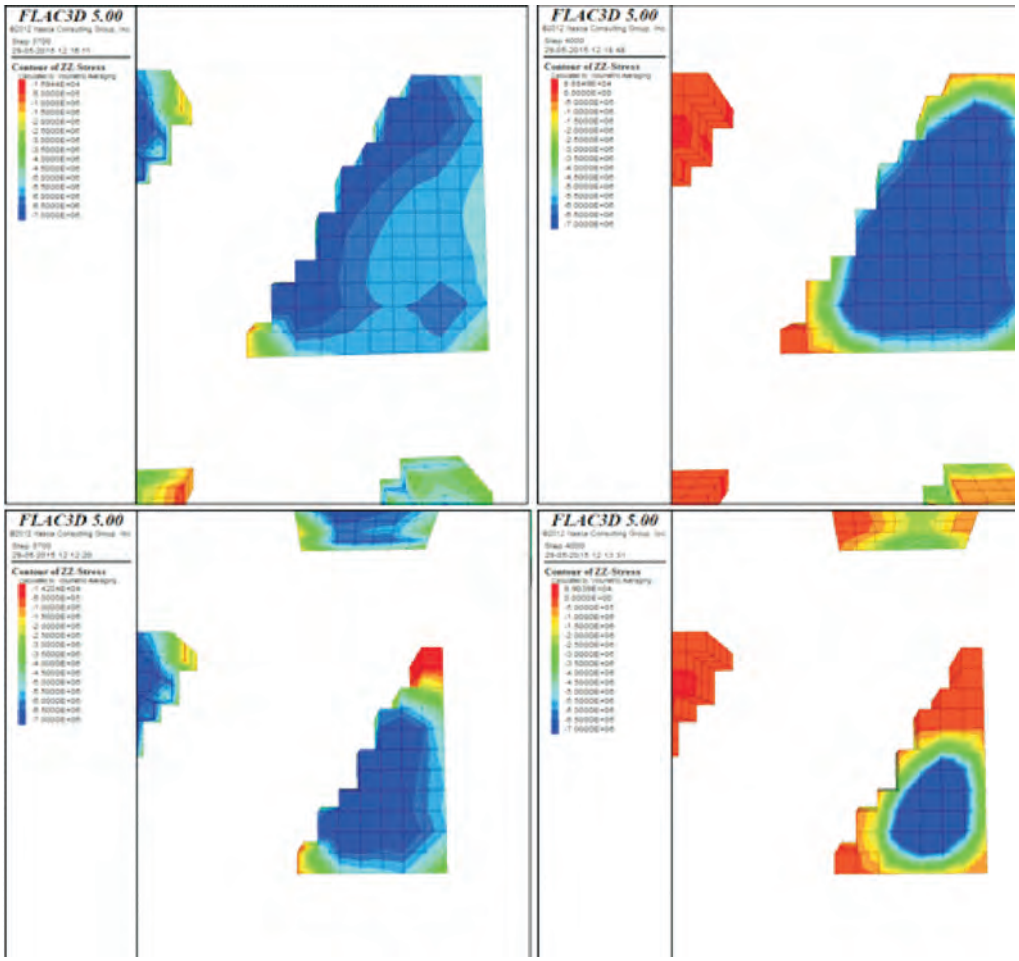
An analysis of results of different field studies, related to the for manner of pillar extraction and rib design during CM based mechanised depillaring, is done to understand the influence of caving characteristics of roof strata over the goaf edge support. Observed nature of variations in the area of a stable rib/snook under different types of the roof strata provided an interesting strata mechanics phenomenon, which helped in conceptualising an approach for the rib/snook design. This idea was matured on the basis of a detailed numerical modeling study and a conceptual model is developed for the design of a rib/snook in mechanised depillaring under varying geo-mining conditions of Indian coalfields.



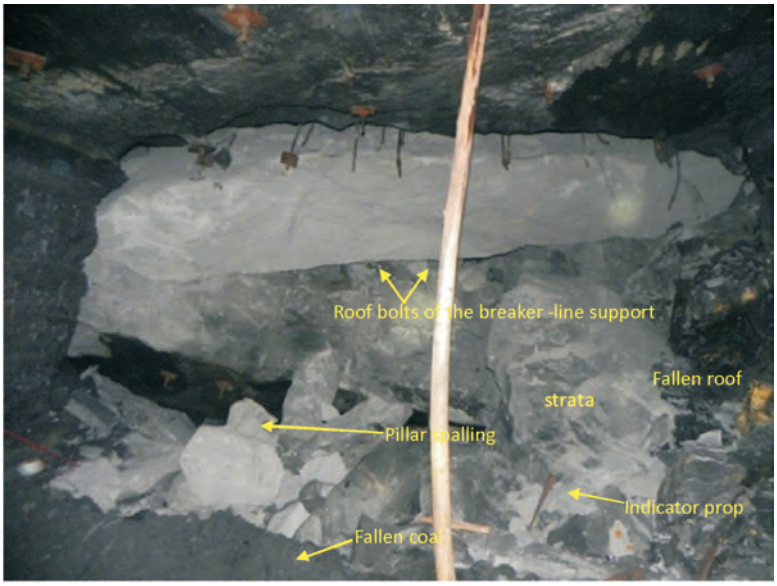
Single pass Splitting & slicing

Formation of irregular shaped rib/snook in two popular manners of pillar extraction.





Plan view of stress concentrations over a rib (of three different sizes) after one and four rows of pillar extractions showing typical failure of thinner part of the smaller rib.



Roof bolt based breaker line failure related goaf encroachment during caving of the roof strata.

9.2. NON-CONVENTIONAL GASES

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

In order to control hazards due to methane explosion in underground coal mines, methane content is monitored during operation either by Methanometer or Locally methane detector (LMD). More than two hundred Methanometer was calibrated for the reporting year. The work is completed.

1.2 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 Methanometer 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 Methanometer found defectives during calibration were also repaired. Advice on working performance of Methanometer was reported to sponsor. The work is in progress.

1.3 Performance Evaluation of Altair 4X Multigas Detector and Advice on its suitability in all type of mines

The performance of Altair 4X Multigas detector was evaluated by simulated condition of underground mine working atmosphere. Heat and humidity are two main factors that affect underground mine environment. The general requirements, safety requirements and environment requirements as per the aforesaid Indian Standard were carried out for checking performance of the instrument. The Altair 4X multigas detector has been tested under environment requirements which have covered heat and humidity tests. The instrument has complied with all relevant clauses and is capable to measure four gases viz. methane (0-5%), carbon monoxide (0-2000PPM), Hydrogen Sulfide (0-200ppm) and oxygen (0-30%). The work is completed.

1.4 Performance Evaluation of Portable Methane Gas Detector , Model Telegas 1000AR

Two nos. of Methane Gas Detector model Telegas 1000AR have been submitted by M/s Teledyne-Ray, Kolkata for their Performance evaluation. The performance was checked as per Indian Standards: 13109 (Part 1 & 21) 1991 and 9937-1981. The instrument is capable to measure methane 0-100%LEL (0-5% by volume) and it has complied with all relevant clauses of the aforesaid Indian standards. The work is completed.

1.5 Performance Assessment and Calibration of Locally Methane Detector (LMD), Bhowrah Colliery, BCCL, Dhanbad

Two nos. of LMDs of Bhowrah Colliery, BCCL was checked for their working performance and calibrated on quarterly basis for one year as per DGMS circular. It was observed that both the LMDs of the mine were working satisfactorily after service and calibration. The work is completed.

10. GEOMECHANICS AND MINE BACK FILLING

10.1. MINE BACK FILLING

During April 2015 to March, 2016, The Mine Stowing and Filling Division has undertaken various scientific studies on stowing in underground mines, backfilling of fly ash in opencast mines,

method of work for depillaring with stowing, rock mechanic instrumentation in stowing panel and coal ash utilization.

The clients are M/s Jindal Steel & Power Ltd, SCCL, NTPC, Western Coalfields Limited, Adani Power Limited, etc.

At the opencast mine of Gare Pelma IV/1, coal ash filling is being carried out by Jindal Steel and Power Limited. Numerical modeling was carried out to provide the design guidelines for filling coal ash along with overburden. It was decided that coal ash and overburden are to be disposed at a ratio of 1:3. Different laboratory and field investigation were carried and presently the filling is being continued by JSPL at the opencast mine.

At Majri colliery, WCL the management proposed to use bottom ash for stowing purpose. The method for using bottom ash for stowing purpose and the design guidelines were provided. It was recommended that the bottom ash can be safely used for underground mine filling.

Korba Super Thermal Power Station, NTPC proposed to dispose bottom ash for underground stowing at Surakachar mine of SECL. The design of stowing plant, underground pipe layout and barricade design were given. Presently the stowing plant is being constructed based on the design given by CIMFR.

The Surguja Power Pvt. Ltd., a subsidiary of Adani Power Limited proposed to dispose coal ash in the nearby opencast operating mine. Accordingly design guidelines were provided for environment friendly disposal of coal ash in the operating opencast mine. The study involved field and laboratory investigation and numerical modelling.

At SRP –1 Mine and RK-7 Incline, SCCL the management proposed to use bottom ash for stowing purpose using bottom ash from Ramagundem Super Thermal Power Station. The method for using bottom ash for stowing purpose and the design guidelines were provided. Presently bottom ash is being safely used for underground mine filling at both the mines.

Scientific study for monitoring of strata movement and stability analysis with the help of geotechnical instruments such as Convergence Indicators, TellTales and Load Cells in the 4SS-2B panel for depillaring with sand stowing of 4 seam at GDK 10 Incline, SCCL, is being carried out. This study helps in assessment of roof behavior during final extraction and take remedial measures as and when required.

Scientific study for monitoring of strata movement and stability analysis with the help of geotechnical instruments such as Convergence Indicators, TellTales and Load Cells in the SS-3 panel for depillaring with sand stowing of 4 seam at Vakilpalli mine of SCCL, is being carried out. The roof condition in this mine is very poor and this study helps to assess the stability in advance thus it is possible to extract coal safely.

SECL has allotted three of its abandoned underground mine for ash filling to Korba Thermal Power Station, CSPGCL. Accordingly CIMFR had carried out the feasibility study of ash filling in these abandoned underground mines. It was recommended to start ash filling operation at Banki 9 &10 Incline.

10.2. GEO-MECHANICS

During April 2015 to March, 2016, The Geo-mechanics & Mine design Division has undertaken various assignment on Rock Mass Characterisation of roof rocks, Design of support system for mine openings and other strata memchanics problems.

The clients are M/s Jindal Power Ltd, Raigarh, SCCL Ltd, Kothagudam, SAIL ,Western Coalfields Limited, Nagpur, HINDALCO, Bharat Coking Coal Limited, Eastern Coalfields Limited, Tata Steel Ltd- Jharia Division, etc.

At Gare Palma coal blocks IV/2&IV/3 at Jindal Power Ltd, design of suitable support system of drift, seam II, III, IV for underground roadways is formulated based on geotechnical studies and Rock Mass Rating (RMR).

At Gare Palma IV/5 coal mines at Milupara , Raigarh, Hindalco, also design of support system for II & III seams is formulated.

At Chanda Rayatwari colliery, Chandrapur Area, WCL design of suitable support system for 4th lift working is to be finalized. Extraction of coal in three lifts has been completed with stowing. Geotechnical studies have already been completed.

At Maheshpur colliery, BCCL, in Sinidih section, design of support system of VIII A seam depillaring panels is formulated using empirical and numerical approaches. The finalisation of the report is in progress.

At Jhanjra, ECL, design of support system for prop free gate roadways of Longwall project is to be decided after the geotechnical study

The outcome of this study would be to provide guidelines for design of suitable support system with roof bolting for mine roadways ensuring better safety and productivity.

Scientific study for monitoring of strata movement and efficacy of support system with the help of geotechnical instruments such as Convergence Indicators and Load Cells in block 14 &15 and block 16 & 17 in XIV seam of Longwall face with stowing and Gate roads at Jitpur colliery, SAIL, is continued for last two years. This would help in assessment of roof behavior during final extraction and take remedial measures, if required.

In Adriyala Longwall Project, Godavarikhani, SCCL strata monitoring for stability evaluation of gate roadways during drivage and extraction is being carried out with the help of instrumentation for safe mining.

At Sijua colliery, Jharia division , Tata steel Ltd, stability of existing galleries are ascertained for installation of pulley grouted chair lift man riding system for transportation. Design of support for existing galleries are also reassessed.

11. BUSINESS DEVELOPMENT & INDUSTRIAL LIAISON

The following events were organized by BDIL Department during FY 2015-16:

1. CSIR Foundation Day was celebrated on 26th September 2015. Foundation Day Lecture was delivered by Prof. T. Kumar, Director, NIT, Durgapur on the topic “Fossil-Fuel for Energy Security and Sustainable Development of India”. On the occasion, felicitation of retirees and presentation of mementoes to the staff who have completed 25 years of service besides honouring wards of staff for various events was organized in a befitting manner.
2. National Science Day was observed on 28th February 2016. Prof. N.V.Chalapati Rao, Department of Geology, BHU, Varanasi delivered the Science Day Lecture on the topic “Meteoritic Impacts and Terrestrial Catastrophes” on this occasion.

12. HUMAN RESOURCE DEVELOPMENT (HRD)

I. Lectures organized at CSIR-CIMFR

- Prof. Bibhu Mohanty, Lassonde Institute of Mining, University of Toronto, Canada delivered a lecture on the topic "Explosives Performance and Rock Blasting: Challenges for Tomorrow" on 4th January, 2016 at CSIR-CIMFR, Dhanbad
- Prof. A.K. Singh, ISM, Dhanbad & Former CMD, ONGC delivered a lecture on the topic " Research and Development in Mining Industry" on 8th January, 2016 at CSIR-CIMFR, Dhanbad.
- Mr. Sajid Mukhtar, MD, Ansari Precision Intstruments Pvt (L), Roorkee delivered a lecture on the topic " i. New Technology of "3D LiDAR" in the field of Mines covering Terrestrial Mobile, airborne & Underground Applications & ii. Slope Monitoring and Stck Pile Measurement" on 9th February, 2016 at CSIR-CIMFR, Dhanbad.
- Dr. Vikram Vishal, Asst Professor, Dept. of Earth Sciences, IIT Bombay, Mumbai delivered a lecture on the topic " Hydro-mechanical Attributes of Unconventional Reservoirs on 19th February, 2016 at CSIR-CIMFR, Dhanbad
- Prof. N.V. Chalapathi Rao, Banaras Hindu University delivered a lecture on the topic " Meteoritic Impact & Terrestrial Catastophies" on 28th February, 2016 at CSIR-CIMFR, Dhanbad

II. Lecture delivered by CIMFR Scientist under R&D Dialogue

- Mr. B. Ahirwal, Sr. Scientist, FLP, CSIR-CIMFR delivered talk on the topic " Recent Development and Role of Ex-Equipment for Mining & Classified Hazardous Area" on 15th January, 2016 at CSIR-CIMFR, Dhanbad.
- Dr. Ranjan Kumar, Sr. Scientist, CSIR-CIMFR delivered talk on the topic " Applied Computing in Geo-Mining Sciences" on 22nd January, 2016 at CSIR-CIMFR, Dhanbad
- Dr. Santosh K Ray, Pr. Scientist, CSIR-CIMFR delivered talk on the topic " Recent Development and Best Practices in Mine Ventilation and Underground Mine Fire Control" on 29th January, 2016.
- Sr. Jaiwardhan, CSIR-CIMFR delivered talk on the topic " Evaluation of Carbon Capture Potential From Thermal Power Plants and Its Storage in Geological Formations in India" on 5th February, 2016
- Sr. Md. Tanweer, CSIR-CIMFR delivered talk on the topic " Application of Fuzzy Logic Technique in Mining Industry" 12th February, 2016
- Sri Basudev Datta, CSIR-CIMFR delivered talk on the topic " Remote Operation Technology for Underground Coal Mines in India" on 26th February, 2016
- Sri Prasad Bhukiya, CSIR-CIMFR delivered talk on the topic " Studies on Optimization of Energy in Mining Industries" on 4th March, 2016.
- Sri Ranjit Kumar, CSIR-CIMFR delivered talk on the topic " Controlled Blasting for Long Term Stability of Pity-Walls" on 11th March, 2016

III. Training organized:

- Training Programme on RMR & RMP on UTM was imparted to BCCL officials during 30 November to 03 December, 2016.
- Executive Training Programme on "FLP Equipment" was organised for the ONGC officials during 28 Mar to 01 Apr, 2016.

Sl. No.	Subject of Training	Name & Address of Participants	Duration
1.	Training Programme on RMR & RMP on UTM	4 Participants of SCCL	30 Nov to 03 Dec, 2015
2.	Executive Training Programme on "FLP Equipment"	9 Participants of ONGC	28 Mar to 01 Apr, 2016

IV. Seminar, Symposium, Workshop, Lecture arranged by your section/division with information, such as; Name and theme, venue and date.

a) Facilitation Provided for CSIR-CIMFR personnel to attend in organised Seminar, Symposium, Workshop: 120 Staff Members

V. Summer/ Vocational/Industrial Training arranged to students of different Indian Universities: No. of beneficiaries: 125 students

VI. Training courses arranged for CSIR-CIMFR personnel:

Sl. No.	Title of the Course	Name & place of Organizer	Name & designation of Staff	Date
1.	Microwave Remote Sensing Applications	National Remote Sensing Centre, Hyderabad	Sri Ajay Khalkho, Sr. Scientist Sri Rakesh K Mishra, Technical Officer	11-22 May 2015
2.	Training & Certification Course for NDT Level-II for UT & MT methods	Trinity NDY Engineers	Sri B. Ravi Kumar, Tech. Assistant	13-19 May 2015
3.	Remaining Life Assessment of Engineering Components	NML Jamshedpur	Ms. Mousumi Mallick, Scientist	18-22 May, 2015
4.	CSIR Leadership Development Programme	HRDC Ghaziabad	Dr. Lalan Kumar, Pr. Scientist	22 June–02 July 2015
5.	Stability and Design of Slope and Dump in Opencast Mines	IIT Kharagpur	Sri Manish Kumar, Technical Officer	15-17September 2015
	Training Programme on "Beti Bachao Beti Padhao" under GoI Scheme	Department of Women & Child Development	Dr. (Major) Chandan	5-6 June 2015

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 708 numbers (Seven hundred and eight) of testing and evaluation reports of various samples including equipment/components were issued by the cell during the year 2015-2016 and an amount of revenue of Rs. 2,30,09,147.00 (Rupees Two crore thirty lakh nine thousand one hundred forty seven) only were generated through the same. This amount includes the foreign currency of US $ 36,611 (Thirty six thousand six hundred eleven U.S. Dollar).

14. TECHNOLOGY MANAGEMENT & ISTAG

(A) ON ISO 9001:2008 Certification Programme:

(1) EXTERNAL AUDIT CONDUCTED BY DNV, NORWAY/ KOLKATA:

(a) 5th Surveillance audit as per ISO 9001:2008 conducted by M/s.DNV on 15th May'15.

(b) Recertification audit as per ISO 9001:2008 successfully conducted by M/s. DNV on 13th & 14th Oct' 2015.

(c) 1st Surveillance audit as per ISO 9001:2008 conducted by M/s.DNVon 30th March'16

(2) INTERNAL AUDIT CONDUCTED BY CSIR-CIMFR AS PER ISO 9001:2008.

(a) Testing group : (Third round of internal audit completed in testing depts.)

(b) Services group : (Third round of internal audit completed in services depts.)

(3) MANGEMENT REVIEW MEETING (M.R.M) :

For the close monitoring & review of quality management system two management review meetings (M.R.M) took place at Directors' level on.

(i) 40th M.R.M conducted on 09th April' 2015.

(ii) 41st M.R.M conducted on 09th Oct' 2015.

(4) Revision & modification of all departmental quality manuals (DQM) as per ISO 9001:2008 completed during the year.

(5) Revision & modification of Apex Quality Manual as per ISO 9001:2008 completed.

(6) Testing, Measuring and Analytical Instruments were sent for re-calibration from national accredited agencies .

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. P. K. Singh	Chief Scientist	22-29 Aug' 2015	Sydney, Australia	To attend conference
2.	Dr. John Loui P	Principal Scientist	7- 15th Dec' 2015	Australia	Mine visit & Technical Discussion
3.	Dr. Debadutta Mohanty	Senior Scientist	1-5 Feb' 2016	University of Queensland, Australia	Technical Discussion

International S&T Projects/ MOU/ Agreement signed during 2015-16:

Sl. No.	Project Title	Agency	Amount (₹)	Date
1.	Accelerated Carbonation of Wastes for valorization and Carbon sequestration in India	Dept. of Environment and Materials Engineering, University of Greenwich, UK.	1.0 Crore	17/09/15

New Agreement as Collaborative Project signed (April' 15 -Mar' 16):

Sl. No.	Title of the Agreement	Party Name and Address	Amount (₹)	Date
1.	Mine Transport Surveillance System	Dadhwal weighing Instrument Repairing Works (DWI), Dhanbad	"NA"	01.07.15
2.	Agreement for collaborative research for the development of Chemical Oxygen Type Self Contained Self Rescuers (SCSR)	M/s. Sure Safety (India) Pvt. Ltd., Plot No.42 A/B, Yoginagar Township, Near Zenith Tins, N.H No. 08, Channi, Vadodara – 391 740, Gujarat, India	4,58,000=00	13.01.16
3.	Fragalyst 4.2 Software	Wavelet Technologies Private Ltd., Pune	"NA"	01.02.16

VII. (E) Premium/ Royalty received during 2015-16:

Sl. No.	Title	Client	Amount ( )	Date
1.	Miner Detection Kit	M/s. Pranay Enterprises, Plot No. 105, Behind Bharat Electronics Ltd., IDA Mallapur, Hyderabad – 500 076	₹1,96,630=00	24/04/2015

2.	Strata Movement Warning System	M/s. Pranay Enterprises, Behind Bharat Electronics Ltd., IDA Mallapur, Hyderabad – 500 076	₹56,180=00	24/04/2015
3.	Resin Capsule	Pawan Enterprises, B-26, Kandra Industrial Area, P.O: Bhitia, Dhanbad	₹4,656=00	11/06/15
4.	Nitrogen Foaming agent for controlling fire in Coal Mine	M/s. COCEEG Associates, 43/8F/1, Jheel Road, Newland, Kolkata-700031	₹20,000=00	31/08/15
5.	Road Dust Collecting and Briquetting System for Coal Mines	M/s. Tata Motors Ltd., Bombay House, 24 Homi Mody Street, Mumbai – 400 001	Principal: ₹6,24,000=00 Income Tax: ₹60,000=00 Total: ₹6,84,000=00	25/08/15
6.	Fragalyst 4.0 Software	Indian Institute of Technology-BHU, Varanasi	₹1,00,920=00	07/01/16
7.	High Set Remote Prop	M/s. Boldie Mining Sealants (P) Ltd., Burdwan, W.B	₹51,043=50	08/01/16
		Total:	**₹11,13,429=50**	

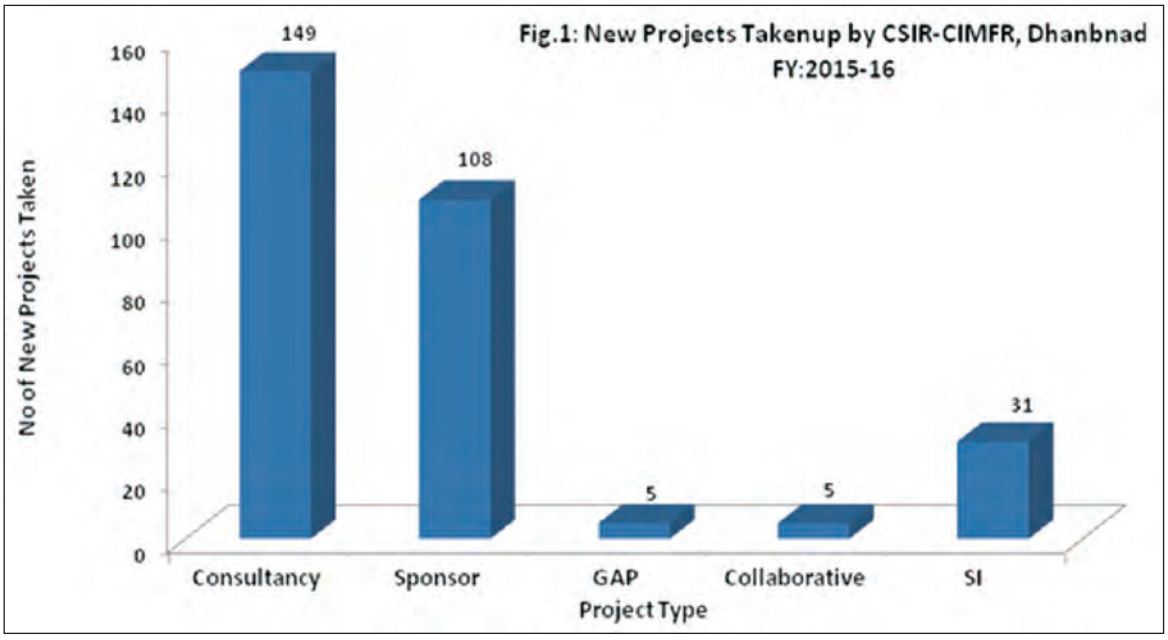
15 PROJECT MONITORING AND EVALUATION (PME) CELL

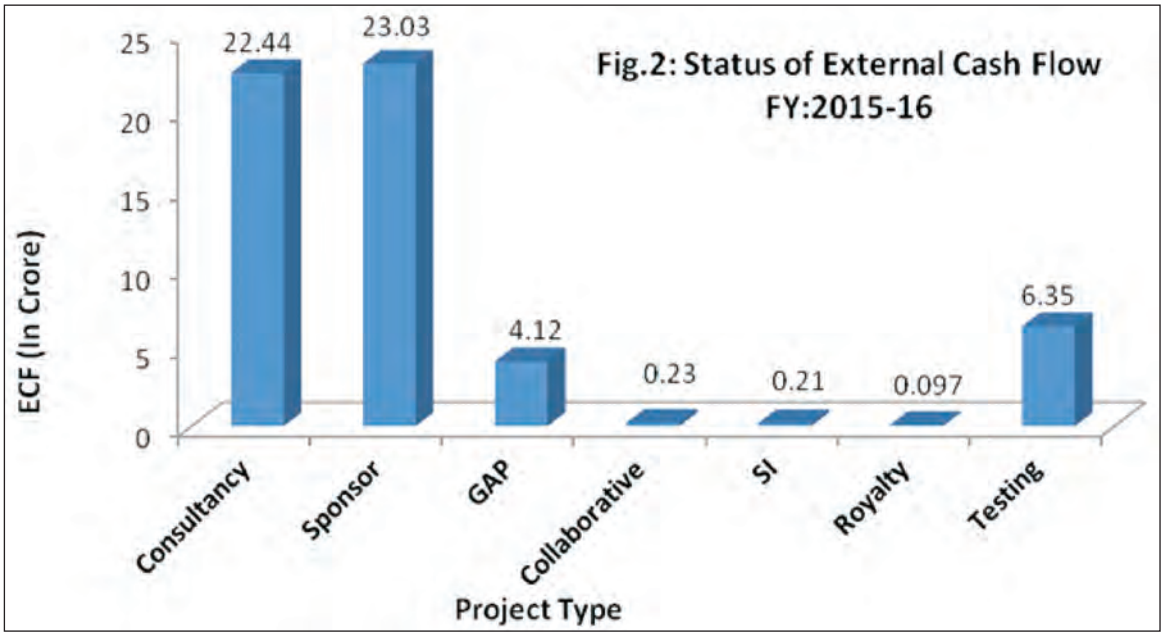
PME Cell of the institute, by virtue of its scope and jurisdiction, has a very onerous task and handling various projects covering the mining and its allied industries. The main activities of PME Cell during the period:

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

As regards the details of projects handled during year 2015-16, it is informed that total of 298 externally funded projects were undertaken and executed, out of which 108 were Sponsored projects, 149 were Consultancy projects, 5 were Collaborative projects, 31 were Service to Industry Projects and 5 Grant-in-Aid projects which are depicted in the form of a bar chart in Fig.-1.

In terms of external total fund received (₹ 56.48 crore), which shows a marked growth of 3% compared to previous year (FY 2014-15), break-up of which is Government fund ₹ 14.02 crore, public sector ₹ 26.42 crore and private sector ₹ 16.04 crore. Project category wise external cash flow of the institute is shown in the Fig.-2.





16 SCIENCE COMMUNICATION AND PUBLICITY DEPARTMENT (SCPD)

Annual Report: Reports related to the activities like R&D work, supporting services, etc, for the year 2014 - 15 were collected from all the departments of the institute, edited, compiled and is in the process of publication in the form of CSIR - CIMFR Annual Report.

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

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

CSIR Annual Report: An abridged report on important R&D work and other technical services of CSIR - CIMFR for the year 2015-16 was prepared and sent for inclusion in CSIR Annual Report.

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

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

Technical Enquiry: During the year 2015-16, a large number of scientific and technical enquiries sent by various organizations in India and abroad were attended.

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

CSIR-CIMFR Project and Work Record Book: CSIR-CIMFR Project and Work Record Book for the year 2016 was published and distributed amongst all the scientists, officers and other staff members of the institute.

CSIR-CIMFR Pocket Address Book: CSIR-CIMFR Pocket Address Book for the year 2016 was published and distributed amongst all the scientists, officers and other staff members of the institute.

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

17. Knowledge Resource Centre (BARWA ROAD CAMPUS)

CSIR-CIMFR KRC is actively engaged in acquisition technical processing and updating the

collection and providing the platform for E-access of information sources to expand the horizon of information base to the scientific community.

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

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

EM Security system at KRC was done successfully.

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

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

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

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

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

Collection Strength

Books, Reports, Standards, Specifications and Bound Volumes	32700
CD Collection	896
Current Journals subscription	62
Translation of Foreign Language Articles	495
Photocopies of Technical Articles	342

18. ELECTRICAL DESIGN

During April, 2015 to March, 2016, Electrical Laboratory has undertaken various assignments on in-situ study and advice on the condition of steel aerial ropes(track and haulage), winder ropes (cage and skip) besides the national level societal mission project on “Third Party Inspection and Monitoring of Projects under RGGVY in the state of Nagaland”, sponsored by Deptt. of Power, Govt. of Nagaland, Kohima, Nagaland.

The clients included: M/s Timber Trail, Asia Resorts Limited, Parwanoo, HP, M/s Damodar Ropeways & Infra Limited, Kolkata, M/s Narwapahar Mines, Uranium Corporation of India Limited (UCIL), Singhbhum (East), Jharkhand, M/s Hindustan Copper Limited, Khetri Copper Complex, Khetri Nagar – 333504, Rajastan, M/s The Singareni Collieries Company Limited, Kothagudem Collieries – 507101, Dist. Khammam, Telengana.

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

1. Four number of track ropes and two number of haulage ropes of Passenger Cable car Aerial Ropeway installation of M/s Timber Trail, Asia Resorts Limited, Parwanoo (H.P.), were scanned and extension of rope use was advised.

2. One haulage rope and two track ropes of Gangtok Ropeway were studied and further continuation of the ropes were recommended.
3. One haulage rope of Maihar Ropeway was studied using nondestructive method and condition of the rope was evaluated.
4. In Science city mono-cable passenger ropeway, Kolkata, present condition of the haulage rope was evaluated and recommended for further continuance in the installation.
5. Two cage and two skip winding ropes in Narwapahar Mines of UCIL, Jharkhand were studied using nondestructive method and recommendation for further continuance in the respective installation was made.
6. Winding ropes of different installations in Khetri and Kolihan Copper Mines of Hindustan Copper Limited were scanned by nondestructive method for evaluation of the condition of ropes.
7. Two ropes of Chairlift Man-riding system-1 and Chairlift man-riding system -2 of Goleti 1-A incline mine and one rope of chairlift man-riding system of RK-6 incline mine of SCCL were subjected to nondestructive investigation for monitoring their suitability in the installation.
8. Three cage ropes each in Main and IIIrd stage winder installations and four skip ropes each in Main and IIIrd stage winder installations in Jaduguda Mines of UCIL, Jharkhand were investigated for monitoring their suitability in the installation.

The department had carried out testing of one Chinese flexible cable, 2 core x 1.2 sq mm for Miners' Safety LED Caplamp as per IS: 2593-1984.

19. MATERIAL TESTING SECTION

1.1 Study the causes of failure of 25mm diameter winding rope used for winding at Dobari colliery, bastacolla area, B.C.C.L., Dhanbad.

The failed wire rope samples of 25mm from Dobari Colliery of 2 pit south side 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.

It appears from the analysis result that the load on the rope exceeded from the normal breaking strength of the wire rope during operation. One strand of the rope was fully elongated during operation. Poor lubrication in the wire rope also aggravated the failure. However the rope was in good condition and the breaking load was also within the range of the rope. It seems sudden impact load was imparted on the rope exceeding the breaking load of the rope and caused failure.

1.2 Failure analysis of 32mm diameter guide rope of 6 pit mine of Katras Choitodih colliery, Katras area, BCCL, Dhanbad, Jharkhand

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.

1.3 Study and Failure Analysis of 32 Mm Diameter Guide Rope of K.B. 10/12 Pits Colliery, BCCL, Dhanbad, Jharkhand

Failed guide rope sample of 32mm diameter from 10/12 pits of KB 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 breaking load of individual wire, tensile strength, torsion & reverse bend.

From the above investigation it has been revealed that the main cause of failure is due to wear and corrosion which is indicative from the high reduction in diameter (57.44%) taken from all single broken wires. The reduction in diameter leads to fracture and thereby failure of tensile nature. Poor lubrication at the broken end of the guide rope may leads to intermittent friction of wires forming nicks, prone to corrosion of the wires. The chemical (carbon content) composition is found to be below the standard requirement.

1.4 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.

It appears from the analysis result that the load on the rope exceeded from the normal breaking strength of the wire rope during operation as most of the fracture ends shows the nature of failure was fatigue failure of wire by abrasion & somewhere nicking and conical tensile failure. Further poor lubrication in the wire rope aggravated the failure.

1.5 Study and Advice on the Effect of Winding on Different Size FLC Construction Ropes Used for Hoisting in Kolihan Copper Mines, HCL, Rajasthan (India)

Ten numbers of FLC wire ropes of Hindustan Copper Limited of Kolihan Copper Mines, Rajasthan were received to study whether it can be continued in the installation or discarded after completing satisfactory service lives. Out of ten numbers of wire ropes, eight numbers of ropes were of 24mm diameter, one of 16mm diameter and rest one of 19mm diameter.

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.Few wire rope samples seem to have a high reduction in diameters (near its critical values). Hence care should be taken in lubricating the wire to avoid further deterioration of the wire rope.

1.6 Study and advice on suitability of vital components other than wire ropes of mine hoisting systems of Khetri Mine & Kolihan Mine of HCL for safe use in future by non-destructive evaluation (CNP/4052/2014-15)

Vital components of winding system of Khetri mines and Kolohan mines of HCL were subjected to Non-destructive evaluation and Field observations has been sent.

1.7 Study and advice on suitability of wire ropes of mine hoisting system of Khetri Mine & Kolihan Mine of HCL for safe use in future by mechanical performance evaluation

In this period three numbers of 51mm dia 6x49 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.

1.8 Study and advice on soundness of the mechanical integrity of the vital components of man-riding (Chair cars / chair lift) systems of SCCL

With reference to Purchase Order No. 7600005338, Dt. 27.01.2014 Non-destructive examinations of vital components of 13 man riding systems were conducted at The Singareni Colliery Company Limited, Khammam Dist, Telngana, for assessment of their quality for further use in the installation. For surface and subsurface imperfections, Magnetic particle crack detection (MPCD) was conducted, whereas, Ultrasonic flaw detection (UFD) for assessment of internal flaws.Vital components of all thirteen man riding hauler system found free from surface and internal flaws of harmful characters except few items like tie rods, guide rods etc. Condition of input shaft, intermediate shafts and main shafts found satisfactory in ultrasonic flaw detection.

Most of vital components of Man riding car systems are highly rusted. Most of white metal socket, bogie shafts and car brackets found free from surface and internal flaws of harmful characters. Most of D-coupling of single link and three link used in 13 man riding car systems revealed the presence of surface imperfections of severe nature.On the basis of this study it is recommended that vital components of man riding system in good condition may be safely used in the installation for next schedule date of examination after getting permission from competent authority, whereas, the defective items must be replaced without delay.

1.9 Study and advice on soundness of mechanical integrity of vital components of winding systems of Jaduguda Mines thruough non-destructive evaluation

With reference to vide work order no. UCIL/NWP/MECH/19/15 dated January 22, 2015 Non-destructive examinations of vital components of cage/skip winding systems and other items except winding ropes of cage & skip winders were conducted at Narwapahar Mines, UCIL for assessment of their quality for further use in the installation. Vital components of cage/skip winding systems include friction wedge rope cappels, hydraulic adjustable link , flat links, cross links, fork links, swivels, pin, ‘D’ shackles, white metal sockets with pin, lifting clamps, drum shafts, sheave pulley shafts etc..

For surface and subsurface imperfections, Magnetic particle crack detection (MPCD) was conducted, whereas, Ultrasonic flaw detection (UFD) for assessment of internal flaws. Condition of most of vital components of the above mentioned items were found free from surface, subsurface and internal flows of harmful character. On the basis of our observations the materials in good condition may be safely used in the installation for next schedule date of examination after getting permission from competent authority.

1.10 Study on soundness of mechanical integrity of vital safety components used in Narwaphar mines thruough non-destructive evaluation

With reference to vide work order no. UCIL/MECH/J/1/14-1515 dated September 4, 2014 Non-

destructive examinations of vital components of cage/skip winding systems and other items except winding ropes of cage & skip winders were conducted at Jaduguda Mines, UCIL for assessment of their quality for further use in the installation. Vital components of cage/skip winding systems include friction wedge rope cappels, hydraulic adjustable link , flat links, cross links, fork links, swivels, pin, 'D' shackles, white metal sockets with pin, lifting clamps, drum shafts, sheave pulley shafts etc..For surface and subsurface imperfections, Magnetic particle crack detection (MPCD) was conducted, whereas, Ultrasonic flaw detection (UFD) for assessment of internal flaws.

Condition of most of vital components of the above mentioned items were found free from surface, subsurface and internal flows of harmful character. On the basis of our observations the materials in good condition may be safely used in the installation for next schedule date of examination after getting permission from competent authority.

2. Testing, Evaluation and Calibration jobs undertaken

During the period April 2015 to March 2016 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 – 38 nos, Safety Hooks- 19 nos., C. S. Gear (Distribution Plate) - 20 nos., Rope Cappel (FWRC) – 25 nos., Bridle Chains – 112 nos., Cage shackle with pin – 74 nos., Pins- 20 nos., Cage Suspension gear complete – 3 sets., Single point CS Gear – 6 nos., Swivel cage & skip set – 6 nos; Cleavy hook – 2 sets, Connector plated – 9 nos, Tub Couplings- (D link with pin) - 32 nos., C type coupling – 110 nos., Drawbar – 30 nos; Sukar rod – 1 no; Haulage rope cappel with pin – 199 nos., Lashing chain – 30 nos., Mine car coupling – 4 nos; Suspesion channel beam – 2 nos; and safety belts – 48 nos,

Total certificates issued to customers – 384nos.

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.

20. Metallurgy Section

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

Objectives:

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

Achievements:

The study is in progress.

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

Objectives:

The objectives of this project are as under:

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

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

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

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

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

Achievements:

Corrosion behavior of few wires rod under varying exposure to mine water/and applied few organic as well as inorganic inhibitor on mild steel to know their property. The study is in progress.

Infrastructure & Technical Services

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

15 reports send in 2015-16 amounting - ₹5,12,498/-

From consultancy project - ₹12,37,177/-

Total ECF amounting - ₹17,49,675/-

21. ROOF SUPPORT TESTING LABORATORY

During April 2015 to March 2016 the Roof Support Testing Laboratory has undertaken various assignments on quality evaluation of mine support, R&D projects including design & development under Dehradun declaration.

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

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

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

Phase – II: Fabrication of various parts / units of the hydraulically operated Drilling Machine for the purpose of Coal sampling and the procurement of Auto Coal Analyzer, all other equipment's and instruments required in the project (i.e. truck and its body layout, eco-friendly generator, Crusher & mixer etc.) have been procured and are ready for installation.

2. A project has been sanctioned on 'Bharat Swachch Mission' launched by PM titled" Design & Development of Wheel Controlled Sewage Discharge System in Trains" under Dehradun declaration.

This project was sanctioned in in-house made to make the track platform as well as total environment more hygienic and healthy in India Railway. Conceptual design of the proposed technology to achieve the objective has been prepared. Procurement and fabrication of the prototype is in process.

3. Project on "Study of Physico-mechanical properties for prototype RCC Tramline Sleeper" of M/s. Naresh Kumar, Dhanbad.

Physico-mechanical properties for prototype RCC tramline Sleeper of M/s. Naresh Kumar, Dhanbad was investigated as per relevant standard. An interim report was issued to the manufacturer in his request.

4. Network Project "Development of suitable design methodology for extraction of coal at greater depth (>300m) for Indian geomining condition (Deep Coal – ESC0303) (Task : N0. 5.4; Numerical Model for realistic simulation of support – strata interaction)"

Associated with the Research Task No. T5.4 of the network project titled (Deep Coal- ESC0303) For detailed drawings (including part drawings) for power support there has been discussion with APHMEL. An agreement with APHMEL is proposed to be signed regarding formulation of S&T project in view of sharing of data for modeling of supports.

The division has also carried out Batch testing of 600 Nos. samples which included 264 Nos. of Steel Cog(50T), 164 Nos. of Steel Telescopic Prop / Adjustable Crossbar Support (30T) and 172 Nos. of Steel Hollow Section Props (30T) capacity from M/s. Bilaspur Mining Industries Private Limited, M/s. Burma Engineering Works, Dhanbad& M/s. Tubes & Structurals, Dhanbad for Axial testing, Eccentric testing & Over Load testing of Steel Cog, SHS Prop & Steel Telescopic Propwhich were tested as per DGMS circular.

22. GEO-TECHNICAL ENGINEERING & UNDERGROUND SPACE UTILISATION GROUP (ROORKEE)

1. Contribution to science

1.1 Appropriate short title of the contribution

Dynamic rock mass quality (Qdyn) for tunnel designs

1.2 Write up on the contribution vis-à-vis comparative international position (abstract of a paper published)

The tunnels in the rock mass are affected by the dynamic loads developed by the seismic stress waves. An approach to estimate the shear wave velocity and concept of ratio of wavelength of earthquake shear waves to tunnel span has been discussed. Various approaches for obtaining the Barton's rock mass quality Q and estimating support pressure in tunnels for dynamic conditions are available. It has been experienced in Himalayan tunnels that a tunnel through weaker rock mass suffers more damage than a good rock mass under similar dynamic conditions. Thus, an attempt has been made in the paper to suggest Qdyn (Q value for dynamic condition) for different ground conditions for tunnels. The proposed Qdyn is suggested to be used for designing the supports using the support chart of Grimstad and Barton (1993).

1.3 Importance of the contribution typically as an input to applied R&D/technology development, new insight into understanding of a phenomenon etc.

The contribution is of applied R&D nature. This would help in improving the understanding of the behavior of rock mass around tunnels in dynamic conditions. The contribution will also provide user-friendly design of tunnel to be excavated through weaker rock masses in seismically prone regions. The contribution would be beneficial for tunnelling industry globally.

Activity-1

2.1 Highway Tunnelling

i. Design of Chenani-Nashri Highway Tunnel of NHAI in this State of J&K.

ii. Review of tunnel design of Kiratpur-Ner Chowk Highway, Himachal Pradesh

2.2 Its application, uses, benefits, advantages, influences;

Construction of an economic and stable road tunnel in the challenging geology of Himalaya using NATM.

2.3 Technical Write-up highlighting the uniqueness, novelty, improvement / advantage / vis-à-vis contemporary S&T and field practices, influences

In Chenani-Nashri highway tunnel (the longest highway tunnel with 9.2km in India) on NH-1A, J&K state, CIMFR reviewed geological and geotechnical data and gave its observations on the report on proposal and sizing of final lining in cross passages, main and escape tunnel junctions. The heading excavation work of main tunnel was completed on July 13, 2015. The final blast for heading excavation in main tunnel was taken in the presence of Hon'ble Sh. Nitin Gadkari, Union Minister, Road Transport, Highways and Shipping, GOI. The project is likely to be completed and commissioned by Dec. 2016.

In the Kiratpur-Ner Chowk highway tunnels, CIMFR reviewed the methodology of treatment of collapsed area in tunnel T4 and support design of tunnels T1 to T5. The collapsed area in T4 has been successfully reclaimed now. The support design has also been revised in all the four tunnels and is being implemented successfully. CIMFR has also advised to implement the instrumentation monitoring for success of NATM.

2.4 Users, licensees, beneficiaries (direct/Indirect) of the development and collaborators, partners, facilitators in development

M/s ILFS (ITNL), Mumbai (Private Sector)

2.5 Quantification of benefits (to the laboratory and to the licensees /users / beneficiaries) such as technology fees, production value, plant capacity, employment generated, productivity savings,. Pollution averted/ mitigated etc.

ECF from two projects: ₹ 1,21,03,520/-

Activity- 2

2.1 Appropriate short title of the development/achievement;

i. Evaluation of Blast Induced Damage by Monitoring of Blasting Vibration during Underground Excavation of PSP Project of THDC India Ltd., Uttarakhand

ii. Blast Design Optimisation & Evaluation of Blast Induced Damage by Monitoring of Blasting Vibration during Rock Excavation at Vishnugaad-Pipalkoti Hydroelectric Project, Pipalkoti,

iii. Assessment and mitigation of blast induced vibration during rock excavation of Tapovan-Vishnugaad Hydroelectric power project

2.2 Its application, uses, benefits, advantages, influences:

Optimum and safe blasting for excavation of tunnels and other underground structures. The suggested blast designs have also improved the productivity and helped in reducing the blast vibrations and impact for the safety of near-by structures.

2.3 Technical write-up highlighting the uniqueness, novelty, improvement/ advantages/ vis-à-vis contemporary S& T and field practices:

The project work required visit to site for field investigation and measurement of vibration. Large data was collected and analyzed to compute dominant frequency & peak particle velocity. Ground vibration characteristics equations have been derived for different projects. This study provides safety of structure of project as well as surrounding villagers.

2.4 Users, licensees, beneficiaries (Direct/indirect) of the development and collaborators, partners, facilitators in the development

THDC India Ltd., HCC, Rithvik Projects Pvt. Ptd.

2.5 Quantification of benefits (to the laboratory and to the licensees, users, beneficiaries) such as technology fees, production value, plant capacity, employment generated, productivity savings, pollution averted/mitigated etc.

Consultancy Fee: App. 60.0 lakhs

Activity-3

3.1 Appropriate short title of the development/achievement;

Geological classification of rock in the DBM and TBM reach of HRT of Tapovan-Vishnugad HEP

3.2 Its application, uses, benefits, advantages, influences;

The study has helped in classifying the rock mass for the use of TBM in varying geology of Himalaya. The results of classification of rock mass in DBM and TBM reach in head race tunnel has also been compared to get the length of tunnel in weaker rock masses.

3.3 Technical Write-up highlighting the uniqueness, novelty, improvement / advantage/ vis-à-vis contemporary S&T and field practices, influences;

The engineering rock mass classification parameters in the TBM excavated portion of the head race tunnel has been back analyzed using the thrust and penetration rate of TBM. This type of study was first of its kind.

3.4 Users, licensees, beneficiaries (direct/Indirect) of the development and collaborators, partners, facilitators in development

L&T Ltd., Faridabad

3.5 Quantification of benefits (to the laboratory and to the licensees /users / beneficiaries) such as technology fees, production value, plant capacity, employment generated, productivity savings,. Pollution averted/ mitigated etc.

ECF from the project: ₹ 15,01,690/-

2. S&T services & facilities

2.1 Any S&T service rendered that has lead to significant gains/contributions of value to the economy, environment, society, national security etc.

Evaluation of damage potential of blast induced ground vibration and air overpressure at Ratle Hydro Power Project

2.2 unique/ major facility(ies) set up and its utility/benefit to clients/users and the extent of its usage.

The blasting being carried out for the excavation of tunnel through fragile and jointed rock masses of Himalaya was a challenging issue. The work has been planned to study the effect of geology on blast results which has helped in establishing the most suitable site specific blast design.

3. Extra-mural human resource development:

- Scientists of the Centre have taken the PGRPE classes of CSIR-CBRI students for the elective on 'Rock Mechanics'.
- Scientists of the Roorkee Centre have delivered lectures in the Training Programme on 'Tunnelling in Poor Rock Condition' for NHPC officers. The programme was organized by Continuing Education Deptt., IIT Roorkee from 04 to 06 Jan 2016 at IIT Roorkee.

23. ROCK MECHANICS & ROCK EXCAVATION RESEARCH GROUP (NAGPUR)

Scientists of the Nagpur centre (Unit-1) are involved in the R&D work with an aim to achieve environmental friendly mineral extraction which ensure work place safety and optimum production at a competitive cost of production. Their efforts has ensured that benefits of research should reach to the clientele through better and practical approach and proper management techniques of mineral extraction. The vibrant Nagpur centre of laboratory undertook number of scientific studies during 2015-16 and most of them were varying in nature and served the basic purpose of improving production and productivity in the mines. Thus, immediate industrial benefits were two folded viz. short term as well as long term. Broadly, the centres R&D activities are grouped in two sections and its brief details are as given hereunder.

Section 1 : Rock Excavation and Fragmentation

Railways, Highways and Metros : The centre has provided consultancy services and advice for design of site-specific safe support and productive blast pattern at tunnel-I and tunnel-2 of Chhindwara-Nagpur broad gauge conversion works of Indian Railways (SEC Railway). The execution of the same was done by applying, controlled blasting techniques and productive rock excavation methods.

To characterize the rock mass, for analysis and design of blasting pattern(controlled blasting), geotechnical investigations services were taken and accordingly design of support system requirements is met out for Marugutti Tunnel near Gulbarga ,Karnataka (SC Railway) and Hassan-

Bangalore new B.G. line of SW Railway. Similar to railways, CIMFR consultancy services are also extended to highway tunnels requiring huge amount of rock excavation work.

Important scientific studies on effect of blast induced vibrations on freshly poured concrete at the underground excavation site of Bangalore Metro Rail Project (for recue shafts, cross passages and tunnel excavation works) has been undertaken. At UG1, Phase1 of BMRCL project, the controlled blasting techniques has fulfilled the objectives to know the effect of blast vibrations on nearby urban structures very critically.

Hydroelectric Projects: CIMFR recommendations on rock blasting work during construction / excavation of hydro-electric power projects were undertaken during April 2015 and March 2016 at following project :

1. Inclined pressure shaft 1 & 2 of Tapovan Vishnugad Hydro-electric power project, Uttarakhand (Phase - 2).
2. Tail race tunnel construction works of Koldam Hydroelectric Power Project, H.P.

Irrigation Projects : Studies on safe vibration limits on tunnels shotcreting and reservoir bund at package 12 of Pranhitha-Chevella Lift Irrigation Project, Karimnagar, AP.

Other Projects:

1. Some other important controlled blast design works were : 'Break through rock plug blasting for lake-tapping works at MV-1, ModakSagar, MCGM, Mumbai' and 'Controlled blasting design to evaluate the permissible vibration level and safe blasting pattern to contain damage to Kalpakkam nuclear construction,Tamilnadu'.
2. Assessment of likely impact on feasibility of low charge blasting at mines of M/s Orient Abrasive Limited was another study undertaken to evolve a safe blasting methodology using low charge blasting in the vicinity of habitats and wildlife.
3. Scientific study on design of safe charge pattern at Chengalathu Stone Quarry, Payyanamon, Pathanamthitta district, Kerala (CNP/N/4309/15-16) and Scientific study on optimization of blast design at Nawabpet-Talamanchipatnam limestone mine of M/s Dalmia Cement (Bharat) Limited, Kerala (CNP/N/4270/15-16).
4. To provide blasting patterns for deep hole blasting, scientific study were conducted at Kathara granite mine in Chattarpur district of M.P.
5. Scientific investigations on controlled blasting practices at mines during FY 15-16 includes - RKP OC, Mandamarri Area, SCCL.A.P.; Kotputli mines of Ultratech Cement Works, Rajasthan and Nongtrai Limestone Mine of Lafarge Umiam Mining Pvt. Limited (LUMPL), Shillong (for expansion of the limestone mining production from 2.0 MTPA to 5.0 MTPA).
6. Stability analysis and prediction of surface movement during tunnelling for Irrigation canal across railway line, studied earlier has benefited the project management authorities to decide the construction of irrigation tunnel under active railway line with increased safety. RITES Limited and CIMFR were involved in this work.

CIMFR advice on 'controlled blasting' were extended to both mines and tunnel for excavation and support. In brief, design of controlled blasting has avoided damage to the surrounding structures and controlled over break thereby providing safe, efficient and speedy excavation.

These projects has achieved an engineering feat in terms of environmental friendly blasting near human settlements. Several trials with modified blast designs were planned and implemented for best utilization of explosive energy. Scientists of the centre are also associated, as project member in Dhanbad HQ Projects.

Section 2 : Geo-technics and Mine Modelling

During the year 2015 - 16, the Geotechnics & Mine Modelling Section of centre has undertaken various R & D studies, which mainly included strata monitoring during high wall mining at MOCP, SCCL, High wall mining design and development of norms for Indian mining conditions as an Indo-Australia Joint R & D project, Design and development of a new bulk head using shotcrete for paste-fill stopes in a lead-zinc mine (SindesharKhurd Mine, HZL, Rajasthan), Design of a Prop for abutment deformation measurement in coal mines as an in-house R & D project, Preparation of systematic support rules for an underground chromite mine, Design of systematic support rules & stoping method below crown pillar at Rampura-Agucha Lead-Zinc mine, Numerical modelling for stope design at an underground lead-zinc mine (in SI-A6 and SK-A2 orebodies of SK Mine and for ore extraction below - 62m RL), Design of web-pillar & barrier pillar at a high wall panel of an opencast coal mine (MOCP), Estimation of RMR & support design in an underground manganese mine, Numerical modelling for stability analysis & design at an underground lead-zinc mine, Instrumentation in Balaghat underground manganese mine (for assessment of stope & cross-cut stability) and Zawarmala underground lead zinc mine (for assessment of geotechnical parameters of stopes), Tailing dam design & barrier stability in an iron ore mine of Sesa Goa Ltd. (Vedanata Resources), Rock slope stability along a proposed railway line. and Shaft stability study at Balaria, Zawar group of mines, HZL.

In the past, the geotechniques and mine modeling group has undertaken large number of industry sponsored R & D studies related to rock mechanics investigation, numerical analysis of complex geo-mining conditions for stope & support designs, design of high wall mining panels, slope stability studies for design & monitoring of pit and waste dump slopes. The sponsoring industries mainly included Singareni Collieries Company Ltd.(SCCL), Hindustan Zinc Ltd.(HZL) / Vedanta Resources, Manganese Ore India Ltd.(MOIL), Tata Steel Ltd., Mumbai Rail Vikas Corp. Ltd., etc.

1. FUEL SCIENCES

1.1 MINERAL TECHNOLOGY & COMBUSTION

Thrust Areas

- Impact of coal qualities and blending in power Plant Performance.
- Estimation of carbon emission factors of Indian coals & lignite and GHG emission coefficients of key sectors
- Mercury emission, trace element assessment from Coal fired Power Plants
- 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

A) Drop Tube Furnace

B) Fuel Evaluation Test Facility

Projects Funded by External Agencies

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

Conclusion: The results suggest that out of nine coals, two coals are most suitable for PCI injection.

Recommendation: To attempt utilization of specified coals and their blends as PCI in Blast Furnace.

Benefits achieved: The proposed study will help the sponsor to utilize specified coals for pulverized coal injection (PCI) in Blast Furnace.

2. 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 sectors were evaluated

Observation: Realistic coal allocation guidelines for 17 different 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.

Recommendation: This report finally recommends allocation of coal quantity

Benefits achieved: This will help to take policy decision by Ministry of Coal

3. Inventory of mercury emissions and releases from thermal power plants

Objective: Measurement of the emissions of mercury from the flue gas of selected power plants

Work done and benefits achieved: Collection of samples from three NTPC power plants viz. Singrauli, Sipat and Tanda completed and analysis is in progress..

Project Funded by CSIR (12th Five year Plan/ Network Project)

1. CLEAN COAL TECHNOLOGY Tap Coal

Objective:

- **Oxy-fuel combustion:**

  Evaluating the effect of coal characteristics and other operating parameters like oxygen concentration, recycle ratio etc. during oxy-fuel combustion

- Co-combustion of coal and biomass:

Co-combustion studies of different types of biomass (green or partially pyrolysed) with coal.).

- 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:

- Different parameters for oxy-fuel combustion studies in Fuel Evaluation Test Facility are optimized.
- Cold model set up successfully worked with Ilmenite for CLC .
- Combustion of coal with different biomass are studied in DTF.

Conclusion: Parameters are optimized for oxyfuel combustion , CLC and Coal-biomass combustion.

Benefits achieved: Knowledge-base generated on low emission or zero emission technologies

2. COAL PREPARATION

During April 2015 to March 2016, the Coal Preparation division has undertaken various projects on washability, sampling of indigenous and imported coals, Value addition from coal slurry wastes, dewatering of coarse coals, Dry beneficiation etc.

The clients included M/s CESC, Kolkata, TATA Jamadoba and West Bokaro, MBE Coal & Mineral Technology India Pvt. Ltd., IISCo Chasnalla, M/s Delkpr Technik Pvt Ltd, Bengaluru, Karnataka Power Corporation Limited, Bengaluru, TATA R & D Centre, Jamsedpur, M/s Jaypee Company, Noida.

Figure – FE-SEM with EDAX

M/s CESC, Kolkata sampling studies were carried out to identify the reasons for GCV loss inside the plant and quantify the same and suggest the remedial action plan to reduce the loss. M/s TATA Jamadoba and West Bokaro studies washability studies were carried out on the coarse fraction and flotation of the coal fines for calculation of total recovery of clean coal, middlings and rejects. Under the Coal S&T project "Development of an On-line Washability analyzer" the laboratory model of the analyzer was installed and initial tests were carried out by the sub-implementing agency. The building for installation of the on-line washability analyzer is also under construction for the said project. The instrument FE-SEM with EDAX was also installed and its commissioning is under progress.

Testing of coking coal fines in pilot scale pneumatic flotation machine supplied by MBE - Pilot plant studies on PNEUFLOT flotation machine using coking coal fines was carried out and compared it with standard Denver flotation tests. The results showed the there is improvement in the yield while the coal fines are tested on PNEUFLOT machine.

Selective Drop breakage studies on coal and stone followed by flotation of coal fines supplied by IISCO, Chasnalla - Selective Drop Breakage Tests on discrete pieces of Coal & Stone from a height of 3 m was carried out for three samples and the results indicated that there the SCI is good and the coal fines was tested for flotation characteristics.

Value Addition from coking coal slimes lying in waste settling ponds of washery - Yhe coking fines lying at the waheries settling ponds were tested for flotation characteristics both on laboratory scale as well as pilot plant scale. The results showed that it is possible to achieve about 50% clean coal at 15% ash level and the quality of the clean coal is good for metallurgical use.

Washability studies of ONE coal sample supplied by TENOVA – Detailed screen analysis and washability studies were carried out on the coal sample supplied by TENOVA and the results indicated that for coal sample provided to CIMFR, it was noticed that partial beneficiation may not be recommended. From the detailed float and sink test, it was observed that the NGM at the required specific gravity of cut is less than 20%, hence Batac Jigs may be an ideal washer to wash such type of coals.

Dewatering studies on coarse clean coal using pilot scale basket centrifuge- Detailed dewatering studies were carried out on the pilot scale centrifuge and the results showed that it is possible to achieve reduction in moisture to the tune of 3%.

Washability studies of ONE coal sample supplied by JAYPEE – Detailed screen analysis and washability studies were carried out on the coal sample supplied by JAYPEE and the results indicated that From the washability curves and the Mayers curves, the theoretical yield is 75% at 18% ash content and 84% at 21% ash content. The washability curves also suggest that the washability characteristics are good.

Washability studies on the samples supplied by KPCL, Begnaluru from Anantha and Jgannath were carried out and the results indicated that it is possible to achieve a yield of 83.7% at 31% ash content and 91.1% at 34% ash content. While in the case of Anantha it ispossible to achieve aubout 84.9% yield at 31% ash content and 89.2% yield at 34% ash content.

Sampling and Analysis at Ten (10) different locations of different coal subsidiaries and SCCL – CIMFR had collected coal samples from different locations and prepared it for different characterization tests w,r,t to proximate and GCV.

Figure – Online Washability Analyzer

Fig – Column Flotation Test Rig

3. COAL CARBONIZATION

1. 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.

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

Summary of the activity: Lignite sample was collected from Naively Lignite Corporation, Tamilnadu. The lignite samples were characterized with respect to its physical and chemical properties with special reference to proximate analysis, ultimate analysis and thermal rheological parameters. Effort was also initiated to repair/ renovation the existing high pressure briquette machine.

3. Studies on preparation of improved coke with high swelling coal and bio-char applying stamp charging technique

Summary of the activity: The objective of the project is to study is to prepare improved coke using high swelling coal and bio-char utilizing stamp charging technique. Bio-char was prepared from different bio sources like waste wood and rice husk under different process conditions and characterized. Two coking coals and one high swelling coking coal were collected and characterized. For optimization of bio-char to coal ratio different blends were prepared and coke pencils were made from these blends. These coke pencils characterized. Four nos. of coke samples were prepared from coal and bio-mass mixture using both top charging and stamp charging technique.

4. 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.

5. 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 CSIR-CIMFR with the objective to explore on the value addition of coke fines.

CSIR-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. 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.

4. COAL GASIFICATION AND LIQUIFACTION

During April 2015 to March 2016, Gasification division has undertaken the different R & D activities in the area of gasification particularly of high ash coal, biomass, coal-biomass blends, petcoke and catalytic petcoke gasification. Our group has also taken up the challenges of different industries to resolve their issues. Most of the studies have been conducted in the existing pilot scale fluidized bed gasifier. Gasification performance for number of high ash coals from different coalfields have been conducted in this setup. It has been found that high ash coals can be gasified without any operational problems like agglomeration/clinker formation. The product gas is tar free and the calorific value of the gas is ranging between 1150 to 1300 kcal/Nm^3. Gasification reactivity and kinetic study of high ash Indian coals, different biomasses (rice husk, saw dust, coconut shell) and their blends with coal have been conducted at different temperature (850°C to 1000°C) in TGA. The data is helpful in the design and development of suitable gasifier for high ash Indian coals and biomass. Surface properties such as true density, particle density, porosity and surface area of high ash Indian coal and biomass have been studied. The data obtained from surface properties is very much useful to select the feedstock for specific end uses. The correlation between physico-chemical properties of feed material and its effect on gasification kinetics have been developed.

Gasification division has also taken up a project from Gujarat Gas Limited (GGL) to assess the potential of coal to SNG production in India.

1. Title of the Project: Pre-feasibility study on Coal gasification to supplement Natural gas with Syngas

Objectives of the Project:

I. Survey of Coal Gasification Technology options available globally according to the types of Coal and their pros and cons.

II. Preferred Technology options suitable for Gujarat Gas Limited (GGL) gas requirements

   a. Technology options for conversion of syngas ($CO + H_2$) into Methane (CH_4)/ Substitute Natural Gas (SNG) .

b. Specification of commingled gas (i.e. Calorific Value) being delivered to the end customers

c. Examining the possibility of setting up of Centralized Coal Gasification Plant in Morbi to generate Coal Gas (converted into Methane) equivalent to 3.5 MMSCMD of Natural Gas. The technology should adhere to the GPCB/CPCB norms and should be able to obtain GPCB/CPCB approvals/clearance

d. Estimated quantity and quality of coal required for running aforesaid Centralized Coal Gasification Plant on long term basis

e. Estimated CAPEX and OPEX for setting up of 3.5 MMSCMD of SNG Plant at Morbi, Gujarat

f. Economic Analysis comparison of Coal Gas (converted into Methane) generated mainly from Imported Coal vis-a-vis Imported Natural Gas (Regasified-LNG)

III. Effluent Treatment Plan and disposal management involved in Coal Gasification Plant adhering to the norms and guidelines of GPCB/CPCB

IV. Health Safety and Environmental (HSE) aspects:

a. Risk analysis in implementation of Coal Gasification project

b. HSE Requirements for Coal Gasification

V. Conclusion & Recommendations.

This approach provides an ideal long-term source of domestic energy because it (SNG) is ultra-clean burning, ideal for future technology uses, and because a vast pipeline distribution system already exists within India.

2. Title of the Project: Clean Coal technology (Tap Coal): Co-gasification of coal with biomass

Objectives of the project:

I. Gasification Reactivity of coal-biomass blends with different gasifying agents

II. Gasification performance of coal and coal-biomass blends in the fluidized bed gasifier (FBG) test facility

III. Ash agglomeration behavior and entrainment during co-gasification of coal and biomass in FBG

IV. Empirical modeling of the data generated in Thermo Gravimetric Reactor (TGR), Fluidized Bed Gasifier (FBG)

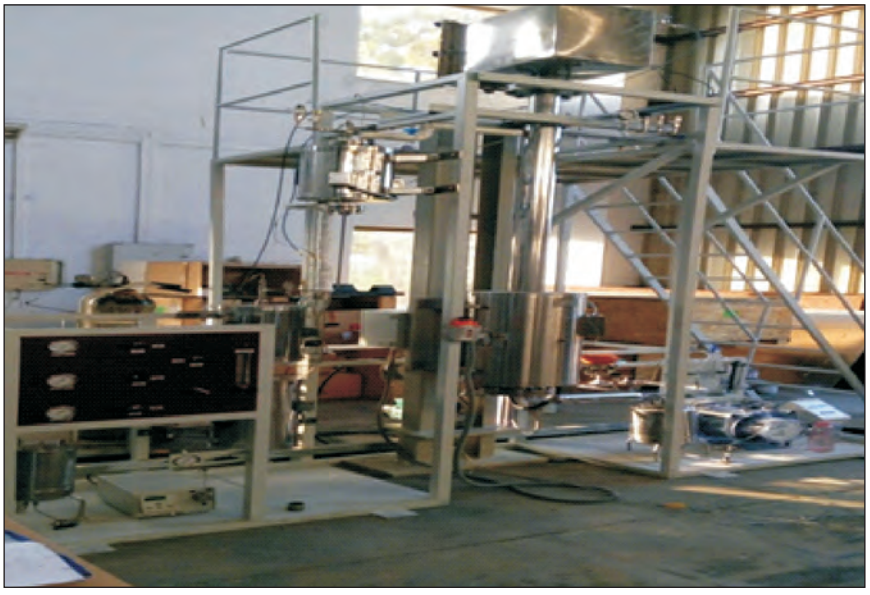
3. Title of the Project: Catalytic Petcoke gasification Study

Objectives of the Project:

I. To investigate catalytic petcoke gasification reactivity/kinetics using thermogravimetric analysis by direct addition of catalyst to petcoke.

Departmental Instruments/Plants

Fluidized Bed Gasification Test Facility



View of TGR Test Facility

Thermo gravimetric Analyzer (TGA)

X-Ray Fluorescence Spectrometer (XRF)

5. RESOURCE QUALITY ASSESSMENT (RQA)

1. Quality evaluation of coal cores explored from different regions of India

The project commenced on 3rd December 2011 and completed on 31st January, 2016.

2. Testing & Analysis (Chemical and Petrography)

The project commenced on 1st April-2015 and completed on 31st March-2016. Several hundreds of coal, coke & other carbonaceous samples were analyzed as aid to industry.

3. Coal quality Assessment from virgin coalfields of Damodar & Mahanadi Valley Coalfields as aid to Power & Steel Industries in India

The project commenced on April' 2012 and completed on July, 2015.

A. Several quality monitoring job of coking and non coking coal dispatches were undertaken from various coal washeries of different subsidiaries of coal companies at loading end and coal received at unloading end. The list of projects is as below:

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

The project commenced on February 2012 and is still continuing.

5. Quality monitoring of coals at station end of NTPC, Vindhyachal Super Thermal Power Project, Singrauli, M.P"

The project commenced on October, 2013 and completed on 15-16.

6. Quality monitoring of coals at station end of TSTPS, NTPC (Talcher- Kaniha), Angul, Orissa"

The project commenced on December, 2013 and completed on 15-16.

7. Quality monitoring of coals at unloading point of NTPC, Vindhyachal Super Thermal Power Project (VSTPPS), Singrauli, M.P

The project commenced on January, 2014 and completed on 15-16.

8. Coal quality evaluation at unloading point of NTPC, Rihand, Dist. Sonbhadra, U.P - Phase-II

The project commenced on January, 2014 and completed on 15-16.

9. Coal quality monitoring at unloading point of NTPC, Unchahar, Uttar Pradesh"

The project commenced on March, 2014 and completed on 15-16.

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

The project commenced on April, 2014 and is still continuing.

11. Coal quality evaluation at unloading point of NTPC, Vindhyachal Super Thermal Power Project (VSTPPS), Singrauli, M. P.

The project commenced on October, 2014 and is still continuing.

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

The project commenced on March, 2014 and completed on 15-16.

13. Comparison of coal as received and coal as fired at Vindhyachal Super Thermal Power Project (VSTPPS), Singrauli, M. P.

The project commenced on October, 2014 and completed on 15-16.

14. Quality evaluation of unloaded coal at NTPC, Kahalgaon, Bihar

The project commenced on October, 2014 and completed on 15-16.

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

The project commenced on January, 2015 and is continuing.

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

The project commenced on January, 2015 and is continuing.

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

The project commenced on January, 2015 and is continuing.

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

The project commenced on January, 2015 and is continuing.

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

The project commenced on January, 2015 and is continuing.

20. Supervision at loading end for quality monitoring of coals dispatched to Vindhyachal NTPC. (Phase –II)

The project commenced on December, 2015 and is continuing.

21. Coal quality monitoring (supervision) at loading end for coals dispatched to NTPC, Vindhyachal, Vindhyanagar, M. P. (Phase –III)

The project commenced on December, 2015 and is continuing.

22. Coal quality monitoring of coals dispatched to NTPC, Rihand, U. P.

The project commenced on January, 2016 and is continuing.

B. Several Bore-hole coal core analyses projects have been taken from virgin blocks of India and abroad. The lists are as follows:

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

The project commenced on March, 2014 and completed 2015-16.

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

The project commenced on March, 2014 and completed 2015-16.

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

The project commenced on December, 2014 and is continuing.

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

The project commenced on May, 2014 and is continuing.

27. Evaluation of Coal quality of borehole coal cores samples received from Tete province of Mozambique through CIAL- Phase III

The project commenced on June, 2015 and is continuing.

28. Characterization of coals from different coalfields explored by CMPDIL RI-II, through boreholes coal cores study – Phase II (For coal cores received from April, 2014 to December, 2015)

The project commenced on July, 2015 and is continuing.

29. Characterization of coals from different coalfields explored by CMPDIL RI-I, through boreholes coal cores study – Phase II (For coal core received between July 2015 to March 2016)

The project commenced on October, 2015 and is continuing.

C. GCV profiling projects were carried out in different plant ends of NTPC. The lists are as follows:

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

The project commenced on September, 2015 and is continuing.

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

The project commenced on October, 2015 and is continuing.

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

The project commenced on October, 2015 and is continuing.

33. Technical advice for efficient combustion behavior of coal at NTPC, Kanti, Muzaffarpur, Bihar

The project commenced on January, 2016 and is continuing.

6. NAGPUR RESEARCH CENTRE (FUEL SCIENCES)

During the period April 2015 to March 2016, CSIR-CIMFR Nagpur Research Centre (Fuel Sciences) has undertaken various assignments in the fields of lithological studies of borehole coal cores, coal sampling & analysis, lab sclewashability tests, Energy management studies, development of new coal technologies This regional center was engaged in 18 Sponsored projects,3 In-house projects and 1- GAP project.One patent has been filed in the Indian patent office Titled"A process for reduction of the overall ash percentage of coal"application No. 1977DEL2015 and is filed on 1st July 2015.The external cash flow during 2015-16 was ₹ 3.68 Crores.

Resource Quality Assessment of borehole coal cores: During the period 7,600.80 meter of coal and lignite core drilled by coal exploratory agencies in 28 blocks of 13 coalfields was received. Out of this 2,667.02 meter of coal core was logged, processed, analyzed and data dispatched.

Technical Aid to industry and Consultancy: During the period, 2,616 coal/coke/lignite/ biomass /oil samples were analyzed for various quality parameters which were received from different coal producer/user industries. Our major clients were M/s Indorama Sythetics, Butibori Nagpur,Raymonds Ltd, Sunflag Iron & Steel Co. Ltd., Bhansali Engineering & Polymers Ltd,

Rattan India Power Ltd, Bharat Aluminium Co. Ltd, PEE-VEE Textiles Ltd, ACC Ltd, Rajiv Gandhi Thermal power plant Hissar, Panipat thermal power plant, DCR thermal power plant Yamunanagar, Virtuas Urja Ltd, Sarda Metals Vishakhapatnam, NSPCL-Bhilai & NTPC-Ramagundam, Bilt Graphic Paper products Ltd Nashik, Deenbandhu -Choturam thermal power project, Maharashtra pollution control board, Century cement, Gupta Global Resources Ltd, Panjab state power corporation Ltd Bhatinda, Adani power Maharashtra, BLA Power Ltd, Jindal power Ltd, GMR Waroraenergy Ltd, GMR Chhattisgarh energy Ltd, KSK Mahanadi Power Ltd etc.

Sponsored Projects:

MAHAGENCO (Maharashtra state power generation company) with power plants in Khaperkheda, Koradi, Chandrapur, Bhusawal, Nashik, Paras, & Parliregularly get their Coal & oil referee samples analysed in the Unit as per the requirement of the state Energy Regulatory authority. M/s MPPGC (Madhya Pradesh power generation companies) with its power generation utility in Sarni also sends us Coal (Imported & indigenous) samples for analysis.

CIMFR Nagpur Research Centre is engaged with third party sampling and analysis of coal at loading sidings of WCL and unloading ends for MPPGCL Power plant at Sarni.

In the sponsored project no SSP-7320“ Study of Washability characteristics of 3-ROM Coal samples of Sasti, Umrer & HLC mines supplied by WCL.

Collected coal samples at Raichure TPS of KPCL. The Screen analysis has been completed. Float & sink tests at 1.3 to 1.9 specific gravity has been conducted and standard washability curves have been plotted. One gravity cut for verification of the specific gravity is going on.

The Nagpur Research Centre has carried out 06 Sponsored projects in the areas of Benchmarking of Specific Diesel Consumption (SDC), Benchmarking specific power consumption (SPC) for Coal India Subsidiaries such as South Eastern Coalfields Ltd. Mines, Bilaspur (Gevra, Dipka, Kusmunda Opencast Mines) , Bharat Coaking coal limited (AKWM Open Cast mine), Western coalfields Ltd (Bhatadi Opencast mine).

Progress: The field study has been complted. The data analysis and simulation work is going on. A potential energy saving of 5-10% was estimated depending on the mine operating conditions.

In House R & D Projects:

MLP-0065:

Objective: To study the effects of blending of imported coal & Indian coal on coal quality parameters.

Progress: Imported & indigenous coal blends with various ratios has been prepared and analyzed. Further work is going on.

MLP-0066:

Objective: To study the suitability of various non-toxic liquids & saccharides for float-sink test of coal.

Progress: Coal samples from 3-different coal-fields of Wardha valley coal-fields are brought, crushed & screened. For comparative study float & sink tests in organic liquids with various size fractions were conducted in the laboratory. Further experiments will be conducted on various in-organic& saccharides solutions.

MLP-0069:

Objective: Systematic compilation of seam wise/block wise/coalfield wise coal quality, coal property and coal ash data for preparation of data bank of virgin coal fields.

Progress: The data compilation work is going on continuously on day to day basis.

GAP-7035:

Title of the project: Optimization of various parameters of lab scale Coal winnowing system" (Phase-II) sponsored by Ministry coal.

Progress: Coal samples from 03 nos. WCL mines have been collected. Size analysis of all three samples has been completed. Float & sink test of individual size fractions is going on. The Coal winnowing system has been modified as per the requirement of the new study.

7. BILASPUR RESEARCH CENTRE

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

Objectives: Characterisation of 82 number borehole coalcore generated from the detailed exploratory drilling in 06 blocks from 4 coalfields done by CMPDIL RI-V. The study includes visual lithological logging of borehole coal cores of around 3300 metre, testing of ash and moisture of band by band samples(around 3300) and preparation and testing of sectional overall samples(around 1000) as per the advice of sponsor. Detailed analysis/ tests viz. proximate, CV, ultimate, AFT, TS and HGI will be conducted for the sectional overall samples based on the seam disposition and overall characteristics of the seam encountered.

Work Done: 3358 number of band by band samples have been analysed and results submitted to sponsor. Besides this 439 samples have been analysed for proximate and GCV each, 102 for ultimate and 80 for AFT , 23 for HGI and 15 for Total Sulphur. Test report has been submitted to CMPDIL RI-V.

2. Characterisation of coals from different coalfields explored by CMPDIL RI-V through borehole coal core study", Phase III.SSP 7235

Objectives: Characterisation of 103 number borehole coalcore generated from the detailed exploratory drilling in 07 blocks from 4 coalfields done by CMPDIL RI-V. The study includes visual lithological logging of borehole coal cores of around 4920 metre, testing of ash and moisture of band by band samples(around 6198) and preparation and testing of sectional overall samples(around 1434) as per the advice of sponsor. Detailed analysis/tests viz. proximate, CV, ultimate, AFT, TS and HGI will be conducted for the sectional overall samples based on the seam disposition and overall characteristics of the seam encountered.

Work Done: All the band by band samples have been dispatched to sponsor after testing and analysis (ash and moisture). Besides this 1037 samples have been analysed for proximate and GCV each, and also including ultimate, AFT & HGI. Test report has been submitted to CMPDIL RI-V.

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

Objectives: Characterisation of 129 number borehole coalcore generated from the detailed exploratory drilling in 08 blocks from 4 coalfields done by CMPDIL RI-V. The study includes visual lithological logging of borehole coal cores of around 4530 metre, testing of ash and moisture of band by band samples(around 5417) and preparation and testing of sectional overall samples(around 1600) as per the advice of sponsor. Detailed analysis/ tests viz. proximate, CV, ultimate, AFT, TS and HGI will be conducted for the sectional overall samples based on the seam disposition and overall characteristics of the seam encountered.

Work Done: All the band by band samples have been analysed for moisture and ash and results submitted to sponsor for further sectional advice. The proximate and GCV of 1079 overall samples which includes ultimate, ash fusion and HGI have been completed and report submitted to CMPDIL RI-V.

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

Objectives: Characterisation of 182 number borehole coalcore generated from the detailed exploratory drilling in 08 blocks from 4 coalfields done by CMPDIL RI-V. The study includes visual lithological logging of borehole coal cores of around 4413 metre, testing of ash and moisture of band by band samples(around 9000) and preparation and testing of sectional overall samples(around 1600) as per the advice of sponsor. Detailed analysis/ tests viz. proximate, CV, ultimate, AFT, TS and HGI will be conducted for the sectional overall samples based on the seam disposition and overall characteristics of the seam encountered.

Work Done: All the band by band samples have been analysed for moisture and ash and results submitted to sponsor for further sectional advice. The proximate, GCV and ultimate with AFT of 537 overall samples have been completed and report dispatched to CMPDIL RI-V.

5. 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"

Objectives: To collect 10 despatch sample from the rakes dispatched from SECL Sidings viz. Govinda, Rajnagar, Chirimiri, Bisrampur, Bhatgaon etc.. Samples are also to be collected from the same rakes from the unloading end at SGTPS, Birsinghpur. Besides one sample each from belt transfer point between 3A/3B and 24A/24B are to be collected. All the samples are to be analysed for Total Moisture, Proximate, Standardised moisture and GCV. Comparative study of samples from same rakes at loading and unloading points is also to be done.

Work Done: Samples are collected from loading and unloading sides from Rajnagar, Chirimiri, Bisrampur, Bhatgaon, Katora, Bijuri etc and SGTPS, Birsinghpur. One sample each from belt transfer point between 4A/4B and 24A/24B are collected. All the samples are analysed for Total Moisture, Proximate, Standardised moisture and GCV. Comparative study of samples from same rakes at loading and unloading points is also done.

6. Lab Scale Washability Study of ROM Coals from Chall O/C Mines, Raigarh Coalfield

Objectives: Around 08 tonnes of rom coal sample will be submitted by party from Chall mine. The sample will be subjected to screen analysis (200,100,50,25,10,06,03 and 0.5mm. Sample will be crushed to 50mm and the crushed product will be screened again in 25,10, 6, 3 and 0.5mm screens. Washability sample will be prepared from 50mm to 10mm. Float and sink test will be taken up using organic liquid of specific gravity 1.3, 1.4,1.5,1.6,1.7,1.8 and 2.0 if required. Single cut washing will be taken up to get cleans with around 33 percent dry ash.Rom,Cleans and rejects will be tested for detailed characterisation. Appropriate graphical representation of the washability data will be prepared and incorporated in the report.

Work Done: Washability and screen analysis are completed and status report has been submitted to the sponsor.

7. Collection of samples from coal supplied to SGTPS, Birsinghpur, MPPGCL from different SECL sidings and their Characterisation.

Objectives: To collect 21 dispatch sample from the rakes dispatched from SECL sidings viz. Katora, Rajnagar, Bijuri, Chirimiri, Bisrampur, Bhatgaon, Govinda etc, All the samples are to be analysed for total moisture and proximate at equilibrated basis.

Work Done: Samples have been collected from sidings from 18th.March to 27th March 2015 and Final report submitted to MPPGCL, Birsinghpur.

8. Quality monitoring of Coals at loading points supplied to MPPGCL from different SECL sidings and their Characterisation.

Objectives: To collect 1421 dispatch sample from the rakes dispatched from SECL sidings viz. Katora, Rajnagar, Bijuri, Chirimiri, Bisrampur, Bhatgaon, Govinda, Junadih, Gevra, Raigarh etc, All the samples are to be analysed for total moisture and proximate at equilibrated basis.

Work Done: Total 762 Samples have been collected from sidings and results of 418 samples have been dispatched to sponsor. Rest samples are under processing for testing and analysis in CIMFR,Bilaspur Laboratory.

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

Objectives:

Characterisation of 182 number borehole coalcore generated from the detailed exploratory drilling in 08 blocks from 4 coalfields done by CMPDIL RI-V. The study includes visual lithological logging of borehole coal cores of around 4413 metre, testing of ash and moisture of band by band samples(around 9000) and preparation and testing of sectional overall samples(around 1600) as per the advice of sponsor. Detailed analysis/tests viz. proximate, CV, ultimate, AFT, TS and HGI will be conducted for the sectional overall samples based on the seam disposition and overall characteristics of the seam encountered.

Work Done: 18253 number of band by band samples (all) have been analysed for moisture and ash and results submitted to sponsor for further sectional advice. The proximate and GCV of 131 overall samples have been completed and report dispatched to CMPDIL RI-V.

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

Borehole coal core	
Received	**24,768.12m**
Result dispatched	**11,561.13 m**
Sample prepared	**17,320**
Total Number of sample prepared	**23,816**
(Including BH, PO, HGI and Projects)	

Name of the testing: 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

8. KNOWLEDGE RESOURCE CENTRE, DIGWADIH CAMPUS, DHANBAD

CSIR-CIMFR(DC), KRC is playing a coordinating role between users and the literature (paper / patent / article/ reference through hard copy & e-version / online access to CSIR-CIMFR research articles via Institutional Repository), providing personal information service through current awareness and selective dissemination of Information using modern information technology.

Besides the day to day circulation, reference and reprographic service, our main attention includes running of a well organized big library with large number of reading materials along with rendering the Documentation, List of latest addition, Bibliographic service, OPAC search, CD-ROM Search, In-house database, Internet Facility & Access to E- journals.

KRC (DC) 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 our scientific / technical community.

Efforts have been made for better comfortable reading environment and more facilities to users.

As per guide line of the official language implementation, KRC is developing variety of collection in Hindi language.

K R C collection strength at a glance:

Books (including reference books), Reports, thesis, Standards, specifications	
and bound volumes of Journals	: 14605
CD & DVD Collection	: 63
Current Journals subscribed	: 55

9. FUEL SCIENCE DIVISION

In our division presently four projects are running. The project titled, 'Prevention of asphaltene aggregation towards improving real term process viability of coal liquefaction' (GAP - 7030, funded by SERB-DST, New Delhi) is running since 31st July 2013. The main objective of this work is to observe the self aggregation phenomenon of asphaltene in molecular scale and develop an easy method in order to minimize asphaltene aggregation by trapping various guest molecules within the asphaltene aggregates for efficient conversion of coal to liquid. In the last year by fluorescence spectroscopy we have been able to establish that coal derived asphaltene (CDA) forms aggregates in CCI4 medium. The new feature of asphaltene aggregate is that even before aggregate formation it can incorporate water molecules and the critical aggregation concentration (CAC) in non-aqueous medium increases with increase In w (= water: CDA mole ratio). Further the fluorescence and NMR spectroscopic determination of the equilibrium constant (K) of the molecular complex of [60] fullerenes with CDA in carbon tetrachloride medium has revealed that K increases on addition of micro-quantities of water.

The structural similarity of CDA and Graphenes has provoked us to venture on a project titled, 'Synthesis of graphenes from coal derived asphaltenes' (Project No. MLP - 0036), that Is running since July 2014. We have been able to detect the graphenes from the soot obtained after the arc discharge experiments of CDA based rods used as one of the electrodes. Further work is on progress. The third project is titled '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' (Project No. MLP-0041/2014-15) has started from 1st July 2014 and will end in July 2016. The objective of the project Is to develop a methodology to reduce spontaneous heating risk in coal & lignite by establishing an improved correlation and categorization of coals according to their proneness towards serf-heatihg tendency using inherent moisture and structural parameters as important factors generally found in low rank coals and lignite. The influence of moisture and oxygen on spontaneous combustion of lignite at various temperature levels has been examined and their possible mechanism has been reexamined. Cause of significant delay to catch fire in the bed of lignite stack even after attaining critical temperature (>70 °C) and some anomalous behavior observed during low temperature oxidation of lignite has been explained in the light of chemical structural parameters. Experimental results have been summarized. An Integrated approach essential for categorization of spontaneous combustion character of coal and lignite for prevention of self-fire in stockpile and mines have been identified.

The fourth project is titled as 'Development of a coal based organic binder for palletization of iron ore fines for suitable application in both conventional and advanced steel making process' (Project No. MLP-0040/2014-15) is running since 1st July 2014 and will end in July 2016. Iron ores mining and beneficlation processes worldwide generate an enormous quantity of fines which as such can not be used for iron making by the conventional steel industry. This project envisages the development of lignite/coal base humic organic binder for pelletizatlon of iron ore replacing Bentonlte that is commonly used as binder. Extraction of humic acid from raw lignite with the application of promoting agent (Sodium pyrophosphate instead of .earllef],anthraquinone) has,been completed. Preparation of humic acid using Wet oxidatloVi of .coal has been carried out. Attempts are being made to optimize the wet oxidation process to maximize the content of fulvic acid in the prepared and extracted humic material. Besides above, some of the routine analysis and tests done for outside parties include Crossing Point Temperature (CPT) and

Ignition point temperature (IPT) In Coal and quantitative determination of various functional groups In coal.

TESTING FACILITIES AVAILABLE :

Conventional:

1. Crossing Point Temperature (CPT) and Ignition point ternperature(IPT) in Coal
2. Quantitative determination of various functional groups in coal.

LIST OF TECHNOLOGIES READY FOR COMMERCIALISATION:

1. Low cost Fly-Ash based Hard Scouring Powder (VS patent granted)
2. Occupationally safe dust generating device for sample preparations of dust especially toxic e.g. quartz.

10. Industrial Biotechnology and Waste Utilisation

1. Potassic (K) fertilizer Technolngy to Empower the Nation (K-TEN) CIMFR Activity: Development of blomass ash/blochar based slow release potassium fertilizer

Outcome/R&D progress during the period

- ❖ Six new ash samples were collected from different blomass based power plants located in Rajasthan, Tamil Nadu, Gujarat and Telangana. Potassium from these ashes was extracted at different experimental conditions using lab scale reactor. Potassium extraction has been optimized with new Inventive steps like decanting and solar evaporation.
- ❖ Process has been up scaled to pilot plant of capacily 100 kg ash/balch
- ❖ Studies on responses of different crops (maize, okra, paddy, spinach, tomato, wheat) to the developed fertilizer showed encouraging resulls.
- ❖ The developed potassium fertilizer has been sent to CWR-CSMCRI Bhavnagar and ICAR-Indian Institute of Sugarcane Research, Lucknow for crop response studies and evaluation.

Contribution to the economy/society

- ❖ Ash generated from the blomass-based power plants is a menace; development of fertilizer from the ashes will offset significantly of the operational cost of the plant.
- ❖ As the entire potassium requirement of the country Is presently imported, this new fertilizer, If adopted on a larger scale will curtail foreign exchange.

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

Stark sampling and analysis of PAH emission from three NTPC. thermal power plants have been completed, Lower molecular weight PAHs were found to be prominent. In gaseous phase where as higher molecular weight PAHs were more prominent In particulate matter.

Contribution to the economy/society.

The data from this study will help to derive PAH emission standards for coal fired thermal power plants of the country.

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

Out come/R&D Progress during the period

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 glowing on the mine spoil have been Identified.
- The soil quality index of different tree species growing on reclaimed coal mine spoils are developed.
- CO_2 emission study carried out by adding different amendments with fresh overburden. The short term trend In C mineralisation rate was modelled assuming SOC decomposition occurred In two pools. Mean residence time (MRT) was found higher In case of biocbar addition, and addition of flyash decreased the C mineralization rate.
- A pot trial experiment has been designed to test the performance of different tree species, in mine spoil amended with different combination of amendments like, coal combustion flyash (FA), Farmyard manure (FYM), poultry manure (PM), and blochar (BC) along with top soil.

Contribution to the economy/society

The data generated would be helpful for mining companies to calculate the carbon foot prints of mining.

- The practical utility of the present study is the screening and Identification of the tree species best suited for carbon sequestration purpose. Trees with highest biomass accumulation and carbon sequestration rates selected from this study can be used as guideline in reclamation of other coal mine OB dumps of India.
- Innovative and practicable strategies for eco restoration research in the country would be developed based on knowledge / data emerging from the research work under the programme.
- Reclamation of coal mine degraded soils will represent a unique opportunity to couple C sequestration with the use of fossil-fuel combustion by-products and other waste materials while achieving ecological, environmental, and societal benefits.

4. CO_2 capture through microbial route (Ptoj No. SSP7219); GAIL (India) Ltd; Jan 2012 to Jul 2015

Outcome/ R&D progress during the period

Filamentous and micro algae based CO_2 mitigation process has been developed for reducing emissions of CO_2

Algae-based CO_2 conversion offers a cost effective option towards reducing our carbon footprint, in addition, Algae-based CO_2 mitigation strategy has the potential to obtain valuable products nt the end of the process

5. Process for synthesis of PHA (polyhydroxyalkanoates)- A biodegradable plastics from biodepolymerized lower rank coal, MI.P -0043, CSIR-Network project; 2016

Outcome/R&D progress during the period

Developed the process for synthesis of PHA (bio Plastics) from blo-depolymerized low grade coal using Pseuodomonus and Bacillus strains, optimum conditions such as different carbon sources, nitrogen sources, pH, Inoculum concentration, Inoculum volume, temperature were studied.

Contiibntlon to the economy/society

PHA has numerous applications in medicine (surgery, transplantation, tissue engineering & make plastic kitchenware, packaging film, other disposable items).

6. CO_2 mitigation & recovery of novel bio-products from coal combustion flue gas using coal industrial effluent through micro algae, CSC 102. CSIR Network; 2013-2017

Outcome/ R&D progress during the period

89 species of new filamentous and single cell algae (Chloarella, Oscillatoria, Spirogyra, Nostoc, Anabaeno, Hydrodictyon etc) have been Isolated and Identified from coal mining areas and process for CO_2 to capture using Industrial exhaust gas from thermal power plants exhaust gas (14-16% CO_2) was developed".

Contribution to the economy/society

Algae-based CO_2 mitigation technologies could provide a key tool for reducing greenhouse gas emissions from coal-fired power plants and reduction of pollutants like NOx; SOx;, soot, ash, droplets of tars and other organic compounds

7. Bio-gasification of Coal, CSC 102. CSIR Network; 2013-2017

Outcome/R&D progress during the period

Developed the process for blogasification of coal and designed "coal/blomass based domestic movable blogas reactor" (CSIR copyright and Design act), Process for co-biomethanation of low rank Indian coal with 17 different blomass substrates were developed. Highly efficient and novel strains of white rot fungi and methanogenic bacteria for coal bio-processing were Isolated from underground coal mines and isolated organisms were patented under IBT

Contribution to the economy/society

Gasification of the coat through biological means Is one of the possible ways to obtain highly efficient and

8. Bio-treatment of coal based Industrial effluents (CBE) using aquatic photoautotrophs and recovery of coal fines. MLP0061. CSIR Network; 2015-2017

Outcome/R&D) progress during the period

Aquatic microphytes Lemma minor, Azolla pinnta and micro algae (Spirogyra, Hydrodictyan spp) were selected for coal Industrial effluent treatments. Coal washery effluent from discharge sites strch as: Howrah ghat, Maura ghat, Bisra bridge, Sudamdth, Bhojudlh were collected and characterised. Coal washery effluent (CWE) T1-CWE:DW(20:80%)

T2-CWE:DW(40:60%). T3-,CWE:DW(60:40%), T4-CWE: DW 80:20%, T5-CWE.-100% and Control-DW(100%) was treated with Lemna minor. The highest amount of total solid (TS) was obs. ed at T5 (38834 mg/l), followed by T4 (28816 mg/1), T3 (26970 mg/1), T2 (15320 mg/1), T1 (4524 mg/1), and control (424 mg/1) The results reveals that the use of coal washery water for growth of Lemna minor, Azolla pinnta didn't show any adverse effect, rather It enhanced the plant growth and root length at moderate concentration.

Contribution to the economy/society

The above selected aquatic photo-autotrophs can be effectively used as treatment of industrial effluents in an eco-friendly manner.

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Book Published

A. J. Das and P. K. Mandal, 2015. "Underground extraction of Locked-Up coal: Numerical modelling based study, 1st Edition, LAP Lambert Academic Publishing, Germany, ISBN: 978-3-659-80250-8, 172 pages.

Attainment of Qualification:

Mr. Rajendra Kumar Vishwakarma. Pr. Scientist has been awarded Ph.D degree in Sept. (2015) from ISM, Dhanbad. The title of thesis was "Experimental investigation of Explosion Parameters under influence of Internal Components and External Apertures of Flameproof Electronic Apparatus"

Mr. J.K, Singh, Sr. Technical Officer (1) has been awarded Ph.D degree in Feb. (2016) from ISM, Dhanbad. The title of thesis was "Optical, Elastic and Electronic Properties of Optoelectronic Materials "

Mr. R.D Dwivedi and Mr. H,K, Verma, Scientists, CSIR-CIMFR Roorkee have been awarded Ph.D degrees from IIT, Rookee in the month of October 2015.

Deputation Aboard

- Dr. Pradeep K Singh, Director, CSIR-CIMFR was deputed to Sydney, Australia from August 24-26, 2015 to present three papers at Fragblast - 11 Symposium on Rock Fragmentation by Blasting and to attend meeting of Organizing Committee of Fragblast international symposium.
- Dr. Pijush Pal Roy, Scientist H was deputed to united kingdom (UK) during 4th to 8th October 2015 for the purpose of bringing experts form UK and Indian Research Institutes and companies together to examine in detail the opportunities for collaboration between both countries in advanced manufacturing the delegation was open to CTOs and R&D Heads of Indian companies and academic researchers for looking R&D business partnerships with

UK companies and Research Centres for the Indian market it included visits of important manufacturing units the state of the art of UK technologies in the manufacturing sector such as digital manufacturing additive manufacturing and other futuristic technologies. The visit was sponsored by the British Deputy High Commission, UKTI.

Awards

"National Mining Engineering Design Award- 2015" has been conferred to Dr. Bhagirath Ahirwal, Sr. Scientist.

PATENTS

Granted in Foreign Countries

SNo	NFNO	Title	Inventors	Application No.	Grant Date	Patent No.
1	0041NF2008/EP	Wireless Information and Safety System for Mines	Lakshmi Kanta Bandyopadhyay, Swades Kumar Chaulya, Pankaj Kumar Mishra	09725268.8	17/Feb/2016	2269088
2	0041NF2008/GB	Wireless Information and Safety System for Mines	Lakshmi Kanta Bandyopadhyay, Swades Kumar Chaulya, Pankaj Kumar Mishra	09725268.8	17/Feb/2016	2269088
3	0041NF2008/CZ	Wireless Information and Safety System for Mines	Lakshmi Kanta Bandyopadhyay, Swades Kumar Chaulya, Pankaj Kumar Mishra	09725268.8	17/Feb/2016	2269088
4	0041NF2008/PL	Wireless Information and Safety System for Mines	Lakshmi Kanta Bandyopadhyay, Swades Kumar Chaulya, Pankaj Kumar Mishra	09725268.8	17/Feb/2016	2269088
5	0117NF2009/US	Device for Roof Support of Underground Mine/Tunnel	Kashyap; Sudhir Kumar; (Dhanbad, in) ; Sinha; Amalendu; (Dhanbad, in)	13/579631	23/Feb/2016	9,267,375

Granted in India

S.no	Nfno	Title	Inventors	Application No.	Grant Date	Patent No.
1	0129Nf2006/In	A Device For Measuring Roof Convergence In Under-Ground Coal Mines/Tunnels	Kushwaha Angad, Kashyap Sudhir Kumar, Singh Satyendra Kumar, Tewari Subhshish, Bhattachrjee Rana	1890Del2006	23/Apr/2015	266305
2	0326Nf2004/In	A Device For Attachment To Hand Held Drilling Machine To Prevent Falling Of Coal On The Face Of Workers During Vertical Drilling In Underground Mine Roofs	Sudhir Kumar Kashyap, Subhashish Tewari	2236Del2004	17/Jun/2015	266941
3	0418Nf2004/In	An Emulsion Composition For Medium And Hard Strata Excavation Work	Braj Mohan Pat Pingua, Md Nabiullah, Jagdish	0311Del2005	20/Jul/2015	267447
4	0214Nf2004/In	An Equipment For Collocting An Unbiased Coal Sample From Open Railway Wagons For Quality Analysis	Sudhir Kumar Kashyap, Subhashish Tewari	1733Del2004	24/Jul/2015	267586
5	0306Nf2005/In	A Stowing Bunker For Hydraulic Stowing Of Sand Or Pond Ash In Coal Mines	Pandey Jai Krishna, Kashyap Sudhir Kumar, Kumbhakar Dilip, Tewari Subhashish	0772Del2006	07/Aug/2015	267936

6	0294Nf2005/In	A Multi -Point Anchoring System For Grounted-Type Borehole Extensometers For Strata Movement Measurement In Underground Excavation	Loui John Porathur, Paul Biswajit	0768Del2006	27/Aug/2015	268353
7	0491Nf2004/In	A Device For Providing Center Lines In A Continuous Manner During Underground Mine/Tunnels Construction	Biswajit Paul	0801Del2005	29/Oct/2015	269614
8	0258Nf2004/In	A Device Useful For Cooling An Individual While Working In Open Cast Mines In Hot And Dry Summer	Bimal Chandra Bhowmick, Santosh Kumar Ray, Dilip Kumar Mitra, Nageshwar Sahay, Rudra Pratap Singh, Ishtiaque Ahmad, Nikh	2139Del2004	28/Dec/2015	270496
9	0213Nf2006/In	A Device For Improved Manual Grouting Of Roof Bolts In Mines	Kashyap Sudhir Kumar, Tewari Subhashish, Sinha Amalendu	2584Del2006	23/Feb/2016	271486
10	0337Nf2003/In	A Composition For The Manufacture Of Flyash Based Rigid Sheet Useful As An Alternative For Asbestos Sheet	Emranuzzaman, Nabiullah, Jagdish, Braj Mohan Pat Pingua, Dhanush Dhari Mishra	0149Del2004	18/Mar/2016	272142

Filed in India

SNo	NFNO	Title	Inventors	Application No.
1	0117NF2015/IN	A process of reduction of overall ash percentage of coal	Devendra Kumar Sakhare, Shripal Singh, Ranjit Kumar Acharya, Prakash D Chavan, Rahul Mehatre, Swati Singh	1977DEL2015
2	0106NF2015/IN	A mine transport surveillance system for monitoring and controlling transportation of minerals for opencast mines	Swades Kumar Chaulya, Girendra Mohan Prasad	2107DEL2015
3	0118NF2015/IN	An intigrated strata, gas and environment monitoring system for underground mines.	Swades Kumar Chaulya, Girendra Mohan Prasad, Ajay Kumar Singh	2477DEL2015
4	0107NF2015/IN	Water resistant ammonium nitrate fuel oil mixture(WANFO) for watery hole blasting and process for preparation the fuel composition	Braj Mohan Pat Pingua	3471DEL2015
5	0243NF2015/IN	A method to design optimum size of rib/snook in mechanised depillaring under moderate roof strata	Singh Rajendra, Singh Arun Kumar, Ram Sahendra, Kumar Ashok, Kumar Rakesh, Singh Amit Kumar	3765DEL2015
6	0234NF2015/IN	Stemming-Plug Augmenting Resistance to Stemming in Holes (SPARSH)	Saharan Mani Ram	201611000896
7	0017NF2016/IN	Local Methane Detector for Hazardous Areas	CHAULYA SWADES KUMAR, PRASAD GIRENDRA MOHAN, SINGH AJAY KUMAR	201611011071

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Human Resource Development

Executive Development Programme on 'FLP Equipment'

28 March – 1 April, 2016

Seating (L to R) : B.D. Rathwa, Prasanta Baruah, Jitendra Meena, M.B. Patel, B.K. Darbe, B.K. Das, R.P. Singh, P.K. Singh (Director), B. Kumar, A.K. Jaiswal, S.K. Singh, R. Lolarak, R.H. Suvera, R.K. Vishwakarma

Standing (L to R) : K.K. Mishra, S.M. Dhan, J.K. Rajak, B.K. Sahu, A. Sarkar, H. Singh, N. Sahay, R.V.K. Singh, R.P. Singh, J.K. Pandey, R. Singh, Arvind Kumar, H.K. Mondal, B. Ahirwal, Naveen Kumar, J.K. Singh, Niraj Kumar

Mr Amitabh Chowdhury, Honorary Joint Secretary, BCCI is being honoured by Dr P. K. Singh, Director, CSIR-CIMFR during 47th SSBMT organised by CSIR-CIMFR

Valedictory function of 47th SSBMT organised at CSIR-CIMFR Stadium