S&T
Annual Report
वार्षिक प्रतिवेदन
2009 – 2010

Government of India
Ministry of Coal
New Delhi 110 001

Central Mine Planning & Design Institute Limited
A Miniratna Company
(A Subsidiary of Coal India Limited)
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प्राक्कथन

कोयला उद्योग के सम्पूर्ण विकास के लिये संगठित अनुसंधान 1975 में सरकार का योजनाबद्ध कार्यक्रम ''कोयला विज्ञान एवं प्रौद्योगिकी योजना'' के अपनाने के बाद ही प्रारम्भ हुआ। इसने कोयला गवेषण से लेकर खनन के पश्चात पर्यावर्णिक विषय तक में व्यापक रूप से अनुसंधान एवं विकास के क्रियाकलापों के सक्षम बनाया है।

सेंट्रल माइन प्लानिंग एण्ड डिजाइन इंस्टीच्यूट लिमिटेड (सी एम पी डी आई एल), कोयला विज्ञान एवं प्रौद्योगिकी परियोजना के समन्वयन एव मॉनीटरिंग के लिये नोडल एजेंसी है।

वर्तमान में कोयला विज्ञान एवं प्रौद्योगिकी कार्यक्रम का संचालन स्थायी वैज्ञानिक अनुसंधान समिति (एस एस आर सी) नामक एक शीर्ष वैज्ञानिक निकाय द्वारा किया जाता है। एस एस आर सी को कोयला अनुसंधान के निम्नलिखित तीन महत्वपूर्ण क्षेत्रों के प्रत्येक क्षेत्र से संबंधित उप-समिति द्वारा सहायता प्रदान की जाती है, ये हैं :

- उत्पादन, उत्पादकता एवं सुरक्षा
- कोयला परिष्करण एवं उपयोग
- पर्यावरण एवं पारिस्थितिकी

1975 से कोयला एवं लिग्नाइट उत्पादक कम्पनियों की सक्रिय सहभागिता के साथ कोयला एवं सम्बद्ध उद्योगों से सम्बन्धित राष्ट्रीय अनुसंधान एवं शैक्षणिक संस्थाओं द्वारा कोयला मंत्रालय के विज्ञान एवं प्रौद्योगिकी अनुदान के तहत् वर्तमान में अनुसंधान परियोजनाएँ क्रियान्वित की जा रही हैं। इसके परिणामस्वरूप अभी तक 187.00 करोड़ रुपये की अनुमानित लागत से 287 परियोजनाएँ पूरी की जा चुकी हैं। कुछ परियोजनाओं की अनुसंधान उपलब्धियों का गवेषण, खनन, पर्यावरण, कोयले की धुलाई, उपयोग प्रौद्योगिकी के क्षेत्र में उद्योग पर महत्वपूर्ण प्रभाव पड़ा है।

इस वार्षिक रिपोर्ट में विवेच्य वर्ष के दौरान 23 चालू परियोजनाएँ एवं 10 पूरी की जा चुकी परियोजनाओं की स्थिति को दर्शाया गया है।

आशा है, यह पुस्तिका कोयला तथा इससे सम्बन्धित उद्योगों में लगे सभी अनुसंधान कर्मियों, माइन प्लानरों/ डिजाइनरों के लिये उपयोगी होगी।

भविष्य के संस्करण को समृद्ध बनाने के लिये प्रस्तुति एवं विषयवस्तु के प्रकाशन में सुधार लाने हेतु आपके महत्वपूर्ण सुझावों का स्वागत है।

(ए. के. सिंह)
अध्यक्ष-सह-प्रबंध निदेशक

FOREWORD

Organized research for all round development of the coal industry started only after adoption of Govt's Planned Programme "Coal Science & Technology Plan" in 1975. This has enabled research and development activities over a wide spectrum of subjects ranging from coal exploration to post mining environmental issues.

Central Mine Planning & Design Institute Limited (CMPDIL) is the nodal agency for co-ordinating and monitoring of coal S&T projects.

The Coal S&T Programme is presently administered through an Apex body known as the Standing Scientific Research Committee (SSRC). The SSRC in turn is assisted by a technical sub-committee, which deals with the following major areas of coal research:

- Production, Productivity & Safety
- Coal Beneficiation and Utilization
- Environment & Ecology

Research projects under S&T Grant of Ministry of Coal are presently being implemented by national research and academic institutions related to coal and allied industries with active participation of coal and lignite producing companies, since 1975. As a result, till date, 287 projects have been completed since inception at an approximate cost of Rs. 187 Crore. Research findings of some projects have made significant impact on the industry in the area of exploration, mining, environment, coal washing and utilization technologies.

This Annual Report describes the status of 23 on-going and 10 completed S&T projects during the year.

It is hoped that this booklet would be useful to all the research personnel, mine planners/designers engaged in coal and allied industries.

Suggestions for improvement of the publication in presentation and content are most welcome to enrich future editions.

(A. K. Singh)
Chairman-Managing Director

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LIST OF ABBREVIATIONS

AMPRI	Advance Materials & Process Research Institute, Bhopal
AMU	Annamalai University, Annamalai Nagar, Chennai
APHMEL	Andhra Pradesh Heavy Machinery & Engineering Limited, Vijayawada
AU	Anna University, Chennai
BCCL	Bharat Coking Coal Limited, Dhanbad
BHU	Banaras Hundu University, Varanasi
CIMFR	Central Institute of Mining and Fuel Research (erstwhile CMRI & CFRI), Dhanbad
CMPDI	Central Mine Planning & Design Institute, Ranchi
DGMS	Director General of Mines Safety, Dhanbad
ECL	Eastern Coalfields Limited, Sanctoria
IISc	Indian Institute of Science, Bangalore
IIT	Indian Institute of Technology, Kharagpur
ISM	Indian School of Mines, Dhanbad
MCL	Mahanadi Coalfields Limited, Sambalpur
NCL	Northern Coalfields Limited, Singrauli
NEC	North Eastern Coalfields, Margerita
NEIST	North East Institute of Science and Technology, Assam
NIRM	National Institute of Rock Mechanics, Kolar
NLC	Neyveli Lignite Corporaation Limited, Neyveli
MEPCO	MRPCO Engineering College, Sivakasi
JU	Jadavpur University, Kolkata
OU	Osmania University, Hyderabad
RDCIS	Research and Development Centre for Iron & Steel, Ranchi
RSMML	Rajasthan State MInes & Minerals Limited, Udaipur
RVC	R. V. College of Engineering, Bangalore
SCCL	Singareni Collieries Company Limited, Kothagudem
SECL	South Eastern Coalfields Limited, Bilaspur
SSRC	Standing Scientific Research Committee
TNAU	Tamil Nadu Agricultural University, Coimbatore
WCL	Western Coalfields Limited, Nagpur
VCRC	Vector Central Research Centre, Pondichery

Production, Productivity & Safety

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2009-10

Field : Production, Productivity & Safety — Project Code : MT/137

1.	**Name of the Project**	:	**Stabiity of parting between coal pillar workings in level contiguous seams during depillaring.**
2.	Date of Start	:	Oct 2004
3.	Scheduled date of completion	:	Oct 2007
4.	Revised date of Completion	:	Jun 2010
5.	Implementing Agency	:	CIMFR, Dhanbad
6.	Project Leader	:	Dr. Rajendra Singh, Scientist, CIMFR
	Project Co-ordinator		Dr. S.K. Singh, Scientist, CIMFR
7.	Total Approved Cost	:	Rs. 50.54 Lakh

DESCRIPTION OF THE PROJECT

8. Objective :

- To develop guidelines for assessing parting stability taking the following factors into consideration.
  - (a) in situ stresses
  - (b) roadway width
  - (c) depth of cover
  - (d) parting thickness
  - (e) eccentricity and
  - (f) RMR
- The guidelines so developed as per first objective would be validated at four selected sites of depillaring. At all the sites, in-situ stresses, magnitudes and directions will be essentially measured.
- To do numerical modelling with an aim to derive a rational formulation for parting stability for depillaring situations.

9. Status as on 31.03.2010 :

Due to non availability of permission for experimental panel the project could not progress as anticipated. Shyamsunderpur Colliery, ECL was selected in consultation with ECL mine management and a meeting with ECL, CIMFR and DGMS officials was held at Sitarampur to discuss various issues related to DGMS permission for depillaring one of the panel at Shyamsuderpur Colliery, ECL. Instrumentation will be done for strata monitoring during depillaring to generate necessary data to validate numerical modeling results after getting permission from DGMS.

10. Slippage, if any :

Due to non-availability of instrumentation panel at Shyamsunderpur Colliery, ECL

11. Action Plan for 2010-11 :

Sl. No.	Activity	Date of start	Date of completion
1.	Validation of guidelines at study site with instrumentation at ECL & SCCL	Continuing	April 2010
2.	Modification of support guidelines, if required	April, 2010	May 2010
3.	Report preparation and submission	May 2010	June 2010

Field : Production, Productivity & Safety — Project Code : MT/150

1.	**Name of the Project**	:	**Underground coal gasification and its utilization for power generation studies in lignite deposits of Rajasthan (Phase-I)**
2.	Date of Start	:	Sep 2005
3.	Scheduled date of completion	:	Aug 2009
4.	Implementing Agency	:	Neyveli Lignite Corporation Limited Neyveli
5.	Project Leader/Project Co-ordinator	:	Director (Mines), NLC Ltd. DGM (Geology), NLC Ltd.
6.	Total Approved Cost	:	Rs. 1125 Lakh S & T Grant – Rs. 562.50 lakh DST Part – Rs. 375.00 lakh Contribution of NLC – Rs. 187.50 lakh

DESCRIPTION OF THE PROJECT

7. Objectives :

- To study and evaluate the exploration data of certain lignite block and selection of a suitable lignite block of UCG studies.
- To undertake detailed exploration in selected lignite block and assess the deposit characteristics, quality and reserves and carryout specialized studies on lignite.
- To establish and carryout UCG pilot sutdies and evaluate the heat values and other characteristics of producer gas.

8. Status as on 31.03.2010 :

No substantial progress could be made in the project as NCL did not appointed International Consultant due to very high demand of consultancy fee. As intimated by NLC steps have been taken to continue with the project and they are having interaction with M/s UCG Mining Technologies & Services Private Limited, New Delhi and their principal M/s Gezprom – Gas, Russia.

9. Slippage, if any :

Due to delay in appointment of consultant through global tender .

10. Action Plan for 2010-11 :

Detailed action plan will be furnished after getting approval of Standing Scientific Research Committee (SSRC).

Field : Production, Productivity & Safety — Project Code : MT/151

1.	**Name of the Project**	:	**Investigation of cavability of overlying strata and development of guidelines for estimation of support capacity for longwall faces.**
2.	Date of Start	:	Nov 2005
3.	Scheduled date of completion	:	Oct 2008
4.	Revised date of completion	:	Sep 2010
5.	Implementing Agency (s)	:	NIRM, CIMFR, ISM, Dhanbad & CMPDI.
6.	Sub-implementing Agency	:	SECL, SCCL, ECL, BCCL, and CMPDIL
7.	Project Leader	:	Dr. V. Venkateswaran, Scientist, NIRM Prof. U. K. Singh, Deptt. of Mining Engg., ISM, Dhanbad Mr. G. Banerjee, CIMFR, Dhanbad
8.	Project Co-ordinator	:	Mr. A. K. Ghosh, CIMFR, Dhanbad Prof. S. N. Mukherjee, ISM, Dhanbad
9.	Total Approved Cost	:	Rs. 461.3674 Lakh CIMFR – Rs. 200.142 lakh NIRM – Rs. 187.910 lakh ISM – Rs. 63.3154 lakh CMPDI – Rs. 10.00 lakh

DESCRIPTION OF THE PROJECT

10. Objectives :

"Development of an integrated approach for selection of the capacity of powered support and formulation of a strata and support behaviour monitoring scheme for longwall operation in Indian coal mines."

The work aims in analysing a few previously worked out and presently running longwall panels and studying the sequence and nature of caving of ovelying rocks by numerical modelling techniques. The steps to achieve the above objectives are as follows :

- Develop a suitable method for the assessment of cavability of overlying roof rocks.
- Categorize the coal measure rock, rock beds based on its caving behaviour.
- Develop guidelines for estimation of support capacity for longwall faces and gate roads.
- Evolve a safety factor for estimation of support capacity.
- Suggest guidelines and requirement of hard roof management techniques for difficult to cave roof conditions.
- Standardization of support condition monitoring techniques to be implemented for the longwall faces and gate roads.
- Standardization for monitoring techniques of strata in and around longwall faces and support behaviour at caving longwall faces and its instrumentation.

11. Status as on 31.03.2010 :

(i) Literature Survey

Extensive literature survey has been done on assessment of cavability of overlying rocks and roof rock classification approaches of the various researchers worldwide.

(ii) Development of an index or parameter for the assessment of cavability of the overlying roof rocks

From plate theory and the mathematical model of Obert and Duvall using the beam and plate theory, a method has been developed for estimation of the equivalent main fall span and this has been compared with the observed main fall span at some of the previously worked out panels. The equivalent main fall span overlying a longwall panel is the main fall span for the main roof with a long face length.

The equivalent main fall span may be used as an index or parameter for the assessment of cavability of the overlying roof rocks.

(iii) Development of an alogorithm for identification of caving strata overlying coal seam

Geo-technical and geo-mining parameters of some of the previously worked out panels in VK 7, GDK 9, GDK10A and PVK-5 Incline mine of SCCL and Jhanjra mine of ECL have been collected and a large number of litho logs of the boreholes at the above mines were collected and studied in details.

Based on the study of the various boreholes over the panels worked out at these mines, an algorithm has been developed to identify the nature and type of the caving strata overlying coal seams.

(iv) Categorization of the coal measure rock, rock beds based on its caving behaviour

Based on the data collected from previous working panels, the parameters have been identified to distinguish the immediate roof, main roof and upper main roof of the overlying strata. The thickness of the immediate roof, main roof and the upper main roof alongwith the equivalent main fall span are the parameters which will be used for categorizing the coal measure rocks.

(v) Development of a numerical model for simulation of the caving of rock beds

A numerical model for simulation of the caving of rock beds with the advance of the longwall face has been developed. This model can be used for predicting the main fall, periodic falls and the variation of the support load, abutment stress, convergence and convergence slope with the advance of the longwall face.

(vi) Field trials for validation of the numerical models and standardisation of monitoring technique

Strata and support behaviour monitoring exercise was carried out at 46L Shortwall panel, Balrampur mine, Bishrampur Area, SECL. Instruments consisting of pressure sensors and convergence recorders along with data logger were installed for monitoring of continuous leg pressure and leg closure of powered supports. From surface, we have also installed micro seismic monitoring system for stability analysis over this panel and data generation for validation of numerical models.

Presently, strata and support monitoring exercise is being conducted at longwall panel No. 3C of GDK 10A Incline mine, RG-III Area, SCCL.

12. Slippage, if any :

Slippage of 30 months due to delay in procurement of geotechnical instruments.

13. Action Plan for 2010 - 11 :

Sl. No.	Activity	Date of start	Date of completion
1.	Field investigation, Collection of data and experimentation at GDK 10A Mine	April 2010	July 2010
2.	Compilation of data and their analyses	April 2010	August 2010
3.	Report preparation	June 2010	September 2010

Field : Production, Productivity & Safety — Project Code : MT/153

1.	**Name of the Project**	:	**Delineation of barrier thickness against water logged working in underground coal mines.**
2.	Date of Start	:	May 2007
3.	Scheduled date of completion	:	Apr 2009
4.	Revised date of completion	:	Oct 2010
5.	Implementing Agency	:	CIMFR, Dhanbad
6.	Project Leader/Co-ordinator	:	Dr. K.K.K. Singh, Scientist CIMFR, Dhanbad Dr. A. Sinha, Director, CIMFR, Dhanbad
7.	Total Approved Cost	:	Rs. 342.2692 Lakh

DESCRIPTION OF THE PROJECT

8. Objectives :

(i) Establishment of GPR signatures for different geological formations, cavities and waterlogged workings.

(ii) Delineation of galleries and pillar from the surface and form underground with the help of GPR survey.

(iii) Delineation of barrier thickness of 60 m from the approachable location to unapproachable workings and extend the same study for unknown working in underground coal mines.

(iv) Verification of GPR survey results with the help of integrated geophysical survey like multi electrodes resistivity imaging survey along with some bore hole data.

9. Status as on 31.03.2010 :

- The commercial bids of the two firms have been opened on 10th February, 2009. The quotation of M/s International Groundradar Consulting Inc. has been found L1 (Lower quotation) and declared qualified commercially by the CIMFR Purchase Committee. Signing of Memorandum of Understanding (MOU) is signed with the techno-commercial qualified bidder (M/s Groundradar, Canada) and Letter of Intent (LOI) is issued to M/s Groundradar, Canada on 10/8/09 for the development of proposed GPR system and order has been placed to M/s Groundradar, Canada.

- M/s Groundradar, Canada has visited the selected locales of the study i.e. East Basuria Colliery of Kusunda Area, BCCL; Tetulmari Colliery of Sijua Area, BCCL; Shyampur B Colliery of Mugma Area, ECL and Barmundia Colliery of Salanpur Area, ECL in the third week of March, 2010 along with their developed prototype GPR System. The visiting team from Canada conducted experimentation at the said locales. Data analysis and its interpretation are in progress.

10. Slippage, if any :

Approximately one year & nine months has been lapsed due to floating of Expression of Interest (EOI) twice and redending of global tender for the development of GPR system.

11. Action Plan for 2010-11 :

Sl. No.	Activity	Date of start	Date of completion
1.	Development of GPR System, Field investigation, Collection of data and experimentation with developed GPR	May 2009	Apr 2010
2.	Compilation of data and their analyses and report preparation	Nov 2009	Oct 2010

Field : Production, Productivity & Safety — Project Code : MT/154

1.	**Name of the Project**	:	**Model studies on gravity blind back filling method and evaluation of a pre jamming indication parameters in the field.**
2.	Date of Start	:	Mar 2008
3.	Scheduled date of completion	:	Feb 2011
4.	Implementing Agency	:	IIT, Kharagpur
5.	Project Leader/Co-ordinator	:	Dr. Samir Kr. Pal, Deptt of Mining Engineering, IIT Khagpur
6.	Total Approved Cost	:	Rs. 402.66 Lakh

DESCRIPTION OF THE PROJECT

7. Objectives :

- Validating the findings on the laboratory model by carrying out field trials on simple hydraulic back filling method by gravity and measuring its efficiency in terms of large area coverage from a single boreholes at shortest possible time.
- To validate the empirical relationship on the estimation of the slope and size of the filled out area in terms of relative spreads in strike and rise direction as obtained from the experimental model study at IIT, Kharagpur.
- Study the variation of inlet pressure based of the slurry with with time during the progress of filling work and to validate the effectiveness of the proposed "Pre-Jamming Indicator" to mark the arrival of final phase of filling. If necessary, suitable modification of this "Pre-Jamming Indicator" will also be done for field applicability.

8. Status as on 31.03.2010 :

(i) 25564 m^3 of sand was procured for stowing

(ii) A vibrator system was installed at the hopper in order to improve the flow of sand – water mixture.

(iii) A brick support below the sand bunker was constructed for improved stability.

(iv) Rimming of stowing boreholes was carried out to 20 inches diameter.

(v) Sonar imaging facility of the ROV camera was used to take sonar images of the underground mine for constructing the mine map. Construction of the underground mine map is in progress.

(vi) Installation of Programmable Logic Controller (PLC) in the caravan was completed.

(vii) The system at the control panel for measuring the flow rates of sand and water was calibrated for accuracy in measurements.

(viii) An ultrasonic system was installed in the sand bunker for sand level indication and to control the electrical vibrator for improved sand flow from the bunker.

(ix) 25 m^3 of sand has been delivered in the mine till date.

(x) Mapping of the sand bed from all direction is under progress.

9. Slippage, if any :

Delayed procurement of the ROV cameras has led to delayed start in the filling process.

10. Action Plan for 2010-11 :

Sl. No.	Activity	Date of start	Date of completion
1.	Field experimentation on gravity blind back filling method from 1st borehole	May 2010	Aug 2010
2.	Verification and modification of empirical relationship obtained from laboratory model studies	June 2010	Jan 2011
3.	Studies on pressure signature variation and evaluation of pre-jamming indication parameter applicable for field conditions , if needed.	June 2010	Jan 2011
4.	Selecting location and drilling of the next feeder borehole. and other accessory boreholes	Aug. 2010	Sep 2010
5.	Preparation steps feeding borehole and continuation in the same way till 30,000m^3 of sand is filled into the underground voids	Sep 2010	Jan 2011
6.	Final analysis and conclusion of the project	Nov. 2010	Feb. 2011

Field : Production, Productivity & Safety — Project Code : MT/155

1.	**Name of the Project**	:	**High resolution seismic monitoring for early delectation and slope failures in opencast mines.**
2.	Date of Start	:	Mar 2008
3.	Scheduled date of completion	:	Feb 2011
4.	Implementing Agency	:	Anna University, Chennai
5.	Sub-Implementing Agency	:	SCCL
6.	Project Leader/Co-ordinator	:	Dr. L. Ajay Kumar, Deptt of Mining Engineering, College of Engineering, Anna Uni Chennai.
7.	Total Approved Cost	:	Rs. 124.30 Lakh S&T Grant : Rs. 99.44 Lakh Contribution of SCCL : Rs. 24.86 Lakh

DESCRIPTION OF THE PROJECT

8. Objectives :

The objectives of this study are :

- Advanced detection and analysis of slope failures of dumps and pit benehes
- Continuous micro-seismic monitoring of pit slopes.
- Scope stability studies in high wall mining
- Suggesting control mourners for stope failure and high walls.

9. Status as on 31.03.2010 :

The Microseismic Monitoring sensors installation Manuguru Opencast Mine high wall is continuously monitoring the seismic events occurring along the slope. Any small seismic event at the rock mass will be recorded by the geophones. The signals are transferred into the Paladin (data logger). The data in turn, is transmitted to the acquisition PC at the control room, by radio signals via repeater station at the dumps. The acquisition PC can store a huge volume of data. Database on a daily basis of all the events is recorded in the folder created. This data can be processed and analyzed live or analyzed anytime later.

The system is collecting data from December 2009, Analysis stations are linked to the base station from Manuguru (Mine site), Kothagudem (R&D Office) and Anna University Chennai. Currently, about 200 active events have been analyzed using the seismic software (HNAS) and the source of the each event h as been located. The magnitude and other important parameters are also found out. The microseismic monitoring system proves a very effective system in collecting seismic data. Till date the seismic data indicates that the mining operations carried below (Punch entries) have not affected the stability of the highwalls.

Detailed technical discussions were held with officials of SCCL and it was decided to install a micro-seismic monitoring station at the internal dump (active) of the Manuguru Opencast Mines. As per suggestions and recommendations of the mining officials of SCCL and based on our previous experience in the installation of the seismic system at the high wall slope, identification of suitable

place for installation of the equipment at the internal dump of the mine was carried out. Various factors were considered such as the height of the dump, visibility of the repeater station, proximity of the dumps to workings and the influence of the mine workings on the dump.

Drilling of the boreholes was carried out, simultaneously followed by the casing of the boreholes with PVC pipe. Geo geophones were rigidly fixed at the bottom of the boreholes so that there not be loss in the seismic data, the grouting of the borehole was done by cement slurry.

The micro seismic system consists of installation of large paladin junction box with directional antennas radar box GPS for time synchronization of seismic wave arrival. The paladin junction box was installed at the gate. The Paladin were connected with sensors and radio antennas for recording and transmitting the seismic wave generated along the dump. The stored seismic data will be processed to internet the magnitude of seismic events and to locate source.

10. Slippage, if any :

Slippage is due to procurement of equipment.

11. Action Plan for 2010-11 :

Sl. No.	Activity	Date of start	Date of completion
1.	Networking and data collection	Continuing	July 2010
2.	Analysis of the data	Continuing	Oct. 2010
3.	Report preparation	Aug. 2010	Feb. 2011

1.	**Name of the Project**	:	**Application of high strength steel roof bolts in underground coal mines.**
2.	Date of Start	:	Jan 2010
3.	Scheduled date of completion	:	Dec 2011
4.	Implementing Agency	:	RDCIS, Ranchi
5.	Sub-implementing Agency	:	DGMS, Dhanbad & CMPDI, Ranchi
5.	Project Leader	:	Dr. B. K. Jha, DGM RDCIS/ Director (S&T), DGMS, Dhanbad
6.	Total Approved Cost	:	Rs. 103.22 Lakh For RDCIS – Rs. 89.02 lakh For CMPDI – Rs. 14.20 lakh

DESCRIPTION OF THE PROJECT

7. Objectives :

- Application of high strength (YS: 600 MPa minimum) 20 mm diameter roll threaded rock bolts for roof support in underground coal mines.
- Evaluate effectiveness of 16mm diameter rock bolts for similar application.

8. Status as on 31.03.2010 :

A meeting was held at Jhanjra Mines, ECL on 19.01.2010 with the participation of representatives from RDCIS (SAIL), Ranchi and ECL regarding the modalities of tests and fabrication of 25mm and 16 mm bolt. Interacted with Durgapur Steel Plant and carried out preliminary tests with 16mm bolt for achieving yield strength of 600MPa. YS up to 580 MPa could be achieved. Interacted with fabricators for conversion of TMT bars into roof bolts.

9. Slippage, if any : NIL

10. Action Plan for 2010-11 :

Sl. No.	Activity	Date of start	Date of completion
1.	Production of high strength rebars	Apr 2010	Dec 2010
2.	Analysis of results	Jul 2010	Mar 2011
3.	Application of developed roof bolts at site	Jan 2011	Sep 2011

1.	**Name of the Project**	:	**Prototype development for methane alarm system using carbon nano fibres**
2.	Date of Start	:	Jan 2010
3.	Scheduled date of completion	:	Dec 2011
4.	Implementing Agency	:	Jadavpur University
5.	Project Leader	:	Prof. A.K. Pal, Department of Instrumentation Science, Jadavpur University, Kolkata
6.	Total Approved Cost	:	Rs. 30.85 Lakh

DESCRIPTION OF THE PROJECT

7. Objectives :

Optimization of the process technology for the synthesis and associated characterization of carbon nanofibers by adopting cost-effective and scalable electro deposition technique for methane gas sensor applications will be undertaken with special attention to the problems identified as: Deposition parameters pertaining to pH of the bath solution

- Si(100) surface treatment
- Graphite electrode surface modification
- Drift due to electronic components
- Contact problems
- Encapsulation of the sensor element
- Prototype sensors will be developed and performance of the prototypes will be monitored. Information on the performance vis-à-vis material properties related to the items indicated above will be looked into to derive meaningful information to improve the technological aspects for realizing marketable methane gas alarm system prototypes.
- These prototypes will be subjected long term stability and reproducibility test.
- Field tests in coal mines to ascertain the viability of the use of such sensors developed under this project.

8. Status as on 31.03.2010 :

The existing electro deposition apparatus was modified to coat Carbon Nano Fibres (CNF) on 5 cm x 5 cm area

Batch production of CNFs is nearly completed. Deposition of suitable ohmic contact for CNF is under trail.

9. Slippage, if any :

Intense photo-effect has been detected in films deposited on small p-Si (110) while films on n-Si showed high TCR effect

10. Action Plan for 2010-11 :

Sl. No.	Activity	Date of start	Date of completion
1.	Small area deposition of CNF with high surface coverage	Jan 2010	Jun 2010
2.	Mounting of the sensor chips	Jan 2010	Jun 2010
3.	Upgradation of electronic circuit	Jul 2010	Dec 2010
4.	Upgradation of process technology for fabricating the prototype	Jan 2010	to be continued

1.	**Name of the Project**	:	**Development and optimization of coal bed recovery process for CO_2 sequestration**
2.	Date of Start	:	Jan 2010
3.	Scheduled date of completion	:	Dec 2011
4.	Implementing Agency	:	ISM Dhanbad
5.	Project Leader	:	Dr. Keka Ojha, Department of Petroleum Engineering ISM, Dhanbad
6.	Total Approved Cost	:	Rs. 22.30 lakh

DESCRIPTION OF THE PROJECT

7. Objectives :

To develop cost effective technology for production of methane from CBM reservoirs.

The major objectives of the investigations are:

- Collection of CBM samples from nearby CBM fields and their characterization.
- To study the adsorption-desorption isotherm of methane and CO_2 with varying compositions at different pressure and temperature conditions. Desorption behavior of methane is the representation of primary recovery of CBM. Investigations will be carried out at dry as well as moist conditions as many Indian CBM reservoirs have high moisture content and required much study for efficient and economic recovery of methane from those.
- Experimentation on recovery of CBM by CO_2 injection with variable pressure, temperature, gas composition and flow rate conditions.
- Modeling and simulation of the system to optimize the CBM recovery

8. Status as on 31.03.2010 :

Literature survey and purchase of equipment is in progress.

9. Slippage, if any : Nil

10. Action Plan for 2010-11 :

Sl. No.	Activity	Date of start	Date of completion
1.	Literature review	Jan. 2010	April. 2011
2.	Procurement of chemicals and instruments	Mar. 2010	Sep. 2010
3.	Fabrication of set up	Mar. 2010	Aug. 2010
4.	Collection and characterization of the coal	July. 2010	Jan. 2011
5.	Experimental works for adsorption-desorption study, CO_2 injection and recovery of the CBM	Aug. 2010	Jun. 2011

Coal Beneficiation & Utilisation

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Field : Coal Benefaction and Utilisation — Project Code : CU/52

1.	**Name of the Project**	:	**Production or [60], [70] fullernes, Hetro fullernes and cabron nanotubes from coal**
2.	Date of start	:	May 2007
3.	Scheduled date of completion	:	Apr 2010
4.	Revised date of completion	:	Feb 2011
5.	Implementing Agency	:	CIMFR, Dhanbad
6.	Sub-Implementing agency	:	BHU, Varanasi
7.	Project Leader/Co-ordinator	:	Shri Ashisk Kumar Ghose, CIMFR/ Prof. O.N. Srivastava, BHU
8.	Total Approved Cost	:	Rs. 175.80 Lakh For CIMFR - Rs. 145.92 Lakh For BHU- Rs. 29.88 Lakh

DESCRIPTION OF THE PROJECT

9. Objectives :

The objective of the project in to produce soot enriched in [60], [70] Fullerenes, Hetrofullerencs and Nanotubes involving indigenous designed reactor system.

10. Status as on 31.03.2010 :

Coke rods were prepared from the coke produced from three coal samples and were subjected to arcing process in a reactor system. After a series exploratory runs to optimise the process parameters of the reactor system finally carbon nanotubes of multi walled nature (MWCNT) were obtained successfully in the product suit which has been confirmed using trasmission electron microscopy. However, the above tests were carried out with the fullerness reactor available at BHU. But the latest fullerness reactor is yet to be procured by CIMFR to attempt more tests and optimize process of producing MWCNT.

11. Slippage, if any :

Procurement of equipments such as Fluorescence Spectrophotometer, UV-Vis Spectrophotometer and Fullerene reactor system could not be done timely at CIMFR due to delay in purchase procedure.

12. Action Plan for 2010 - 11 :

Sl. No.	Activity	Date of start	Date of completion
1.	Carrying out experiments in fullerene reactor system	Jan 2010	Dec 2010
2.	Product analysis and characterisation	Jan 2010	Dec 2010
3.	Selection of suitale 'host' compounds	Jan 2009	May 2010
4.	Separation of fullerenes by utilizing 'host-guest' chemistry	Jul 2010	Dec 2010
5.	Analysis of data & preparation of reports	Jan 2010	Feb 2011

Field : Coal Utilisation **Project Code : CU/54**

1.	**Name of the Project**	:	**Catalytic Liquefaction of Neyveli Lignite**
2.	Date of start	:	Feb 2009
3.	Scheduled date of completion	:	Jan 2012
4.	Implementing Agency	:	Mepco Schlenk Engineering College, Sivakasi
5.	Project Leader/Co-ordinator	:	Dr. N. Krishnamurthy Mepco Schlenk Engineering College, Sivakasi
6.	Total Approved Cost	:	Rs. 14.00 Lakh

DESCRIPTION OF THE PROJECT

7. Objectives :

- Study of depolymerization of Neyveli lignite using phenol and catalysts such as p-toluenesulphnic acid, sulphated zinconia and MCM-41 supported HPA.
- Characterization of the products of depolymerization.
- Liquefaction of the depolymerized product byalkylation using olefins as the alkylating agents.
- Analysis of the products by GC/MS.
- Optimization of the reaction parameters for high conversion and better liquefaction.
- Consolidation of reports and submission of the same to CMPDI.

8. Status as on 31.03.2010 :

Lignite samples were collected from Neyveli. Depolymerisation of Neyveli Lignite is carried out using heteropoly acid catalysts (HPA). Extractability of raw lignite and depolymerised lignites are carried out in organic solvents Pyridine extractability is enhanced from 11 % (raw lignite) to 58 % (depolymerised lignite) indicating the cleavage of coal structure.

9. Slippage, if any : Nil

10. Action Plan for 2010-11 :

Sl. No.	Activity	Date of start	Date of completion
1.	To optimize the conditions of depolymerisation to maximize the extractability of depolymerised lignites in organic solvents	Apr 2010	Sep 2010
2.	To carry out the depolymerisation of Neyveli lignite using other catalysts like sulphated zirconia	Oct 2010	Dec 2010
3.	Characterization of the products of depolymerisation and purchase of chemicals for alkylation reaction	Jan 2011	Mar 2011

1.	**Name of the Project**	:	**Biological production of clean fuels from lignite**
2.	Date of start	:	Feb 2009
3.	Scheduled date of completion	:	Jan 2012
4.	Implementing Agency	:	RV College of Engineering, Bangalore
5.	Project Leader/Co-ordinator	:	Prof. (Dr.) Pushpa Agrawal RV College of Engineering, Bangalore
6.	Total Approved Cost	:	Rs. 45.36 Lakh

DESCRIPTION OF THE PROJECT

7. Objectives :

- To design the anaerobic bioreactors for the conversion of lignite into clean fuels.
- Optimization of the parameters such as amount of moisture content, temperature, pH and hydrogen concentration.
- Isolation of the bacteria from the gut of the termites and their pure culture andmaintenance of their population.
- Utilization of the isolated bacteria for the conversion of the lignite under optimized conditions.
- Estimation of the byproduct obtained after the lignite.
- Complete elimination of reductions of the impurity like sulphur.
- Cost effective production of the fuels using the existing and modified organisms.
- Estimation of the efficiency of the clean fuels that are environmental friendly.

8. Status as on 31.03.2010 :

Digestion of lignite can be done by two methods (i) Solubalisation, (ii) Fermentation, the lignite which is hydrophobic in nature requires the solubalisation process to break down into its components. The solubalisation process was carried out in two different methods viz. pre-treatment method and auto clay method. The pre-treatment method is carried out using different chemicals to increase the oxidation condition of the lignite and to introduce nitro groups into aromatics rings thereby increasing the microbial attack on the lignite. In this process, lignite supplied by NLC was crushed using more tar and pestle and sieve into various size 8, 12, 22 and 52 mess numbers through the smaller the size faster the liquefaction process, but mess number 22 h as been selected for further experiment due to impregnation and penetration of smaller droplets in the ager. The pre-treated lignite was subjected to solubalisation process.

9. Slippage, if any : Nil

10. Action Plan for 2010-11 :

Sl. No.	Activity	Date of start	Date of completion
1.	Optimization of the parameters	Continuing	Jan 2011
2.	Characterization of fuel obtained	Continuing	Jan 2011
3.	Bio-product analysis and investigation of the quality of the fuel	Continuing	Oct 2011
4.	Economic analysis and study of environmental issues	Aug 2011	Jan 2012

1.	**Name of the Project**	:	**Re-design and fabrication of biomass gasification plant coal fuel utilization.**
2.	Date of start	:	Feb 2009
3.	Scheduled date of completion	:	Jul 2010
4.	Implementing Agency	:	RV College of Engineering, Bangalore
5.	Project Leader/Co-ordinator	:	Dr. M. Krishna, Director, RV College of Engineering, Bangalore
6.	Total Approved Cost	:	Rs. 40.06 Lakh

DESCRIPTION OF THE PROJECT

7. Objectives :

- To design and develop co-gasification (Dual Fuel : Coal/Lignite + Bio-waste) technology by using existing biomass gasification unit.
- To optimize carbon/biomass ratio for efficient power generation.
- To develop an efficient gas cleaning technology.
- To increase power generation capacity (power out put/size of the system).

8. Status as on 31.03.2010 :

The proximate analysis and finding the temperature of drying, thyrlsis, combustion and reduction zone for gasifier using K type thermocouple (1200°C) ± 5°C. The chemical composition of syn gas for CO_2, CO, CH_4 and H_2 are found.The remnants of gasification was measured using weighing balance and flow rate of producer gas was measured using a calibrated venture meter. The power generated using syn-gas by Cummins Engine (100 KVA). The overall coal gas efficiency of the gasifier and the thermal efficiency of the engine, prepares saw dust and lignite pellets to use in gasification.

9. Slippage, if any : Nil

10. Action Plan for 2010-11 :

Sl. No.	Activity	Date of start	Date of completion
1.	Study the operation of lignite /biomass dual fuel more gasification unit	Continuing	Apr 2010
2.	Studies of environmental issues	Continuing	Jul 2010
3.	Final report	May 2010	Jul 2010

1.	**Name of the Project**	:	**Development of indigenous catalyst through Pilot Scale Studies of Coal-To-Liquid (CTL) conversion technology.**
2.	Date of start	:	Jan 2010
3.	Scheduled date of completion	:	Dec 2012
4.	Implementing Agency	:	CIMFR, Dhanbad
5.	Sun-implementing Agency	:	CT Deptt., CMPDI, Ranchi
6.	a. Project Leader	:	Dr. Sudip Maity, Scientist
	b. Project Co-ordinator	:	Dr. Amalendu Sinha, Director
7.	Total Approved Cost	:	Rs. 805.40 Lakh For CIMFR : Rs. 688.50 Lakh For CMPDI : Rs. 116.90 Lakh

DESCRIPTION OF THE PROJECT

8. Objectives :

(i) developing suitable catalysts and to study the coal-to-liquid conversion technology in Pilot Scale in an integrated plant consisting of low cost air blown gasifier and a multi-tubular fixed bed reactor (Catalyst Capacity: 10.0 L).

(ii) testing high ash Indian coals in the gasifier.

(iii) generating basic design & process parameters for further scale-up to commercialization.

(iv) characterizing the products (liquid and gaseous) and its up-gradation/processing for commercial use.

9. Status as on 31.03.2010 :

Three iron based catalysts have been prepared and their characterization is in progress. Experimental runs will be conducted in the existing facility after completion of the catalyst characterization and recruitment of the Project Assistants. A technical committee has been made for finalization of the Technical Specifications for the Coal –to-Oil Plant procurement. Advertisement for the recruitment of the 06 (six) Project Assistants have been made. Purchase orders have been placed for procurement of high surface area Alumina Spheres, Water Gas Shift catalysts and synthetic gas mixture equivalent to coal gasification product.

10. Slippage, if any : Nil

11. Action Plan for 2010-11 :

Sl. No.	Activity	Date of start	Date of completion
1.	Updating of knowledge and literature	Jan 2010	To continue
2.	Recruitment of temporary project staff	Jan 2010	May 2010
3.	Design, procurement , installation and commissioning of integrated CTL pilot plant	Jan 2010	Oct 2010
4.	Preparation and characterization of catalysts	Mar 2010	To continue
5.	Test run of sample catalysts in existing 100 ml fixed bed reactor	Jul 2010	To continue

1.	**Name of the Project**	:	**An approach to explore the applicability of spectro-radiometry as a tool for assessment of coal quality.**
2.	Date of start	:	Jan 2010
3.	Scheduled date of completion	:	Dec 2012
4.	Implementing Agency	:	CIMFR, Dhanbad
5.	Project Leader	:	Dr. Ashok K. Singh, Scientist , CIMFR
6.	Total Approved Cost	:	Rs. 147.61 Lakh

DESCRIPTION OF THE PROJECT

7. Objectives :

To establish the spectro-radiometry as an efficient handy tool for coal quality assessment in the field.

8. Status as on 31.03.2010 :

Repairing and calibration of existing instrument in CIMFR Laboratory. Purchase of spectrometer reflectance unit and other accessories are under process. Geological details has been gathered regarding different coalfields for preparation of field visits.

9. Slippage, if any : Nil

10. Action Plan for 2010-11 :

Sl. No.	Activity	Date of start	Date of completion
1.	Literature survey	Jan 2010	Continuing
2.	Reconnaissance survey of study area	Jan 2010	Continuing
3.	Recruitment of two nos. Project Assistant	Jan 2010	Continuing
4.	Field work for mapping, collection of spectro-radiometric data and samples	Jan 2010	Continuing
5.	Procurement / Repair of instrument and other items	Jan 2010	Continuing

Environment & Ecology

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Field : Environment & Ecology — Project Code : EE/30

1.	**Name of the Project**	:	**Fly ash characterization for mine void reclamation**
2.	Date of start	:	Nov 2003
3.	Scheduled date of completion	:	Oct 2006
4.	Revised date of completion	:	Jul 2010/Jan 2010/Oct 2008
5.	Implementing Agency	:	CMPDI, Ranchi.
6.	Project Co-ordinator	:	GM (Env.), CMPDI, Ranchi
7.	Total Approved Cost	:	Rs. 287.684 Lakh

DESCRIPTION OF THE PROJECT

8. Objectives :

- To identify and characterize samples of power grade coal from mines from major coalfields in India producing power grade coal and supplying coal to identified TPS.
- To characterize the PFA produced from coal from indentified mines and establish relationships between trace elements present in coal and its PFA.
- To carry out standard leaching tests on ash samples and characterize the leachate produced with respect to its potentialities in polluting ground water.
- To test the properties of PFA to assess its suitability as material for structural fill so that end uses of reclaimed land other than growing plantation, can be thought of, including development of townships on such land.
- Foreign grade coal to be tested w.r.t. the above three issues, to compare its eco-friendliness vis-a-vis Indian coal.
- To analyze slope stability of the dump formed by backfilling fly ash (PFA) and dump material in two scenarios
    - Fly ash (PFA) and overburden material are mixed during the backfilling
    - Fly ash (PFA) and overburden material are dumped in layers.

9. Status as on 31.03.2010 :

The samples have been collected from Korba STPS, Amarkantak STPS, Singrauli STPS, Ib TPS, Talcher TPS and from mines of SECL, NCL & MCL. The samples from CCL and BCCL and their respective thermal power plants were also collected and sampling is complete. Slope stability analysis study has been outsourced to BIT Mesra along with physical characterization of coal and fly ash

samples. The chemical analysis has been outsourced to ISM, Dhanbad and the results were received. The project duration has been extended by 6 months to complete the balance work under the project.

10. Slippage, if any :

Delay in procurement of equipment.

11. Action Plan for 2010-11 :

Sl. No.	Activity	Date of start	Date of completion
1.	Procurement of the Equipment, Installation & Commissioning	Continuing	May 2010
2.	Analysis of Samples	Continuing	Apr 2010
3.	Interpretation of results	Continuing	Apr 2010
4.	Report Preparation	Continuing	Jul 2010

Field : Environment & Ecology — Project Code : EE/31

1.	**Name of the Project**	:	**Development of suitable biological wastewater treatment technology through constructed wetands for treatment of acid mine drainage from coal projects.**
2.	Date of start	:	Aug 2004
3.	Scheduled date of completion	:	Jul 2007
4.	Revised date of completion	:	Dec 2010/Jun 2009
5.	Implementing Agency	:	CMPDI Ltd., Ranchi
6.	Sub-implementing Agency	:	Western Coalfields Ltd, Nagpur
7.	Project Leader	:	GM (Env.), CMPDI, Ranchi
8.	Total Approved Cost	:	Rs. 78.62 Lakh

DESCRIPTION OF THE PROJECT

9. Objectives :

- Design of Anoxic lime stone drain.
- Identification of plant species capable of bio-degrading the acid mine drainage.
- Design of organic substratum of wetland to support plant species.
- Assessment of treatment efficiency and operating parameters for treatment of the acid mine drainage by the plant species through bio-degradation.
- Development of a simple and cost-effective bio-treatment system to treat the acid mine drainage from the coal mines, so that it could be made potable.

10. Status as on 31.03.2010 :

(i) **Identification of plant species :** The plant specie Typha has been identified for the purpose.

(ii) **Design of wetlands :** The design of wetland system, based on the characteristics of AMD and availability of site has been completed. The same has been finalized after input from WCL authorities. The design, drawings, BOQ and cost estimates have been submitted to WCL for implementation.

(iii) **Implementation of the scheme :** The implementation of the scheme is now in progress. As per the work order no. WCL/ KAN/SO(C)/AL/C-1995/09-790 dated 19-23/12/2009, the likely date of completion of construction is June, 2010.

11. Slippage, if any : Nil

12. Action Plan for 2010-11 :

Sl. No.	Activity	Date of start	Date of completion
1.	Construction of the treatment system	Continuing	Jun 2010
2.	Monitoring of the treatment process and its parameters	Jul 2010	Nov 2010
3.	Compilation of field data	Apr 2010	Nov 2010
4.	Preparation of report & submission	Jun 2010	Dec 2010

1.	**Name of the Project**	:	**Study on blasting dust management system in an opencast coal mines.**
2.	Date of start	:	Oct 2006
3.	Scheduled date of completion	:	Sep 2009
4.	Revised date of completion	:	Sep 2010
5.	Implementing Agency	:	NIRM, MCL & NCL
6.	Project Leader/Project Co-Ordinator	:	Mr. Surendra Roy, NIRM Dr. G. R. Adhikari, NIRM
7.	Total Approved Cost	:	Rs. 48.33 Lakh

DESCRIPTION OF THE PROJECT

8. Objectives :

- To study the meterological conditions at the mine sites.
- To assess the ambient air quality at the study site due to blasting.
- To study the influence of rock density and blast design parameter on dust emission.
- To develop emission factor for the quantification of dust emission due to blasting.
- To develop predictive estimation equation for the dust concentration at particular location.
- To find out central measures for the dust generation due to blasting.

9. Status as on 31.03.2010 :

Surface coal mining contributes to about 70 per cent of the total coal production in India. It has an edge over underground coal mining in terms of production, productivity and safety. However, surface mining causes adverse impacts on the environment. Blasting, which is one of the major operations at surface mines, is associated with environmental hazards such as ground vibration, air overpressure, flyrock and dust. Even though blasting is a short-lived phenomenon, the dust generated due to the use of explosives in rock fragmentation at large mines may cause air pollution, particularly when a cluster of large mines are operating in the same coalfield. If the blasting dust is ignored in each of the mines, the air quality in that coalfield is likely to be deteriorated, which will have serious consequences on human health.

Previous studies have attempted to assess and control air pollution caused by various mining operations such as drilling, loading, hauling and crushing. Very little work has been conducted on blasting dust and its management. Considering the increasing trend of surface mining and the growing scale of operation of individual mines, it is essential to assess the dust generated due to blasting and to adopt suitable control measures.

The generation of blasting dust depends mainly on the source parameters like blast details, rock and explosives characteristics. The dissipation of blasting dust in vertical and lateral directions depends basically on atmosphere and meteorological conditions. Therefore, a comprehensive study was conducted at Dudhichua opencast coal mine, involving collection of blast details, rock and explosives details, dust sampling, study of atmospheric boundary layer and meteorological conditions.

For this purposes, sodar, automatic weather station and respirable dust samplers were installed at the mine site in all the seasons.

SODAR stands for sound detection and ranging. A tri-axis monostatic (back-scattering) sodar, manufactured by Global Environmental Technologies, New Delhi, India, with a technical know-how of the National Physical Laboratory, New Delhi, India, was installed at the project office building of Dudhichua project. Sodar was operated continuously for 24-hours in post-monsoon (October-November), winter (January-February), summer (April-May), and monsoon (August-September) for different days. Over 2000 sodar echograms recorded at the mine site for different seasons were analysed and classified into different categories. Using sodar echograms and corresponding mixing heights, stability classes for the mine site condition were determined.

An Automatic Weather Station of Lawrence & Mayo (India) Pvt. Ltd. was installed at the time office building of the mine and meteorological parameters such as, wind speed, wind direction, surface temperature, humidity, solar radiation and rainfall were monitored in each season. The influence of these parameters on mixing height was studied in all the seasons. Windroses diagrams plotted in different seasons.

Respirable dust samplers, Instrumex IPM 115BL, were used for measurements of particulate matter, both TSP and PM10. This dust sampler utilises a two-stage collection system for fractionating the particulate matter sizes. The first stage consists of a cyclone through which the particles greater than 10 mm sizes are separated from the air stream by centrifugal forces acting on the solid particles. The separated particulate falls through the cyclone's conical hopper and collected in the plastic cup placed at its bottom. PM10 is collected from the ambient air in the second stage by filtering the air stream through the glass microfibre filter. TSP consisted both PM10 and the particles greater than 10 mm size. Whatman GF/A filter papers of 203 mm x 254 mm size were used for collection of PM10 and plastic cups for the particulate matter greater than 10 μm size.

For particulate monitoring in an industrial area, often the respirable dust samplers are operated either in three shifts of eight hours duration or continuously for twenty four hours at fixed locations. In case of blasting dust monitoring, it is not possible to keep the samplers at a fixed location because blast location changes time to time. Also the monitoring cannot be done for hours because the dust emitted by blasting is dispersed quickly into the atmosphere. For the monitoring of dust, the sampler needs 230 V power supply for maintaining the flow rates greater than 1.1 m3/min. In the mine, high voltage power of 6600 V was supplied by the main station through electric cables for the operation of heavy duty machineries such as drill machines, shovels, and draglines. As high voltage power could not be used for respirable dust samplers, the power of 230 V was taken only through the sockets of 230 V, available in the cabins of heavy duty machineries. For the safety point of view, sometimes high voltage power cable passing near the blast locations were disconnected to the heavy duty machineries. Hence samplers could not be operated. Sometimes no any source of power supply was available near the blast bench. To overcome this problem, sometimes a petrol generator was also used for the operation of samplers depending on the site condition because fly rock may cause fire to the generator. Since the amount of dust collected by the samplers depends on the wind direction, the samplers once installed towards downwind direction could not be reinstalled due to deviation in wind direction at the time of blasting. Mud, water logged area around the blasting site and rain interfere the dust monitoring in monsoon.

Dust samplers were installed at safe distances from the blast site along the downwind direction. The safe distance depended on the size of blasts. Also installation of the samplers at a large distance was not suitable because the blasting dust would get mixed in the ambient air and hence it would be difficult to identify the contribution of dust by the blasting. Before installation, many blasts were observed for the accumulation period of dust towards downwind direction and accordingly 20 minutes monitoring periods were considered for sampling. After this period, the emitted dust was dispersed completely into the atmosphere. Usually during the blasting period, all the activities of the mine were stopped. Therefore, blasting dust monitoring was not affected by the other activities. The number of samplers installed depended on the site conditions. Figure 4 shows locations of respirable dust samplers towards downwind direction of the bench to be blasted. Electric shovel connected with samplers for power supply as well as high walls available on the other side of the bench are also shown in the Figure. All the partial or non collection of particulate matter data due to change of wind direction, getting the samplers tripped during monitoring period, etc were discarded. Dust samplings were carried out in all the four seasons.

Blast details such as number of blastholes, blasthole depth, blasthole diameter, burden, spacing, stemming column, and explosives type and its quantity were noted for the coal and overburden benches in each season. The number of blasts monitored included coal and overburden for shovel-dumper and dragline benches. The details of blasts corresponded to dust monitored benches. Rock density of the mine benches was determined by weight and volume method. The rock samples from the mine benches were collected and their density was determined at National Institute of Rock Mechanics Laboratory. Moisture content has restraining nature in dust generation. It may vary from season to season as well as with respect to depth of the benches. Therefore, assessment of moisture content was carried out in each season. For this, samples of drill cuttings, generated just after completion of drill holes in the bench, were collected and moisture contents were determined in Coal Analysis Laboratory of the mine.

The following conclusions were drawn from the study:

Thermal plumes (free) occurred during the day time whereas spiky, flat, stratified and multiple layers formed during the night time. Rising layers were observed during transition phase in the morning some time after sunrise. Dot echo structures were found during rainfall. Echograms provided real-time information about onset and dissipation times of convective and stable boundary layers. The mixing height was the highest during 12:00 and 14:00 in all the seasons. Stability classes A, C, E and F were predominant at different times of the day for all the seasons. These classes can be used to know dispersion coefficients for calculation of emission rates for different mining activities including blasting dust. The predominant wind direction as indicated by windrose diagrams for different seasons can be used to minimise the impacts of blasting dust by planting fast growing trees perpendicular to blasting dust plume towards habitations. Varying degree of simple correlations of meteorological parameters with mixing height was established, the highest being with solar radiation. Multiple regression analysis of data indicated the combined influence of meteorological parameters on mixing height. It also established that solar radiation has dominant influence. The developed statistical model can be used at the mine site to compute mixing height. Dispersion factor was high during 10:00-15:00 for all the seasons but for effective control of blasting dust, blasts at the mine can be scheduled during 12:00-13:00 in post-monsoon and monsoon and during 13:00-14:00 in other two seasons. Results of the study will also be useful for control of dust due to other mining activities.

Correlations and scatterplots matrices indicated correlation between pair of predictors for the inference of multicollinearity, suitability for the use of no-intercept models and influence of predictor variables on dependent variables. Positive correlation of TSP and PM10 with blasthole depth, blasthole diameter, burden, spacing, explosive quantity revealed that as these parameters increased dust generation increased. An increase in distance showed decrease in dust concentrations. Significant negative correlations of moisture content with particulate matter indicated decrease in dust generation with increase of moisture content. Thus moisture content played a key role for the control of blasting dust generation. Moisture in the benches can be increased by water spraying on the surface of the benches before blasting. Stepwise regression procedure entered stemming column, explosive quantity, distance and moisture content as predictors for PM10 whereas blasthole diameter, explosive quantity, distance and moisture content for TSP assessment. Models adequacy checked by various statistical methods showed that developed models can be used for prediction of PM10 and TSP generated during bench blasting in the mine. Since dust monitoring cannot be carried out at long distances due to lifting nature of blasting dust but assessment of dust by predictive models in the mine can help to know the contribution of blasting dust into ambient air and hence to reduce its impacts on surrounding environment.

10. Slippage, if any : NIL

11. Detailed Action Plan for 2010-11 :

Sl. No.	Activity	Date of start	Date of completion
1.	Technical evaluation and interpretation of data generated	Oct 2009	Jun 2010
2.	Report preparation	Jul 2010	Sep 2010

1.	**Name of the Project**	:	**Development and use of fly ash based pesticides**
2.	Date of start	:	May 2007
3.	Scheduled date of completion	:	Apr 2011
4.	Implementing Agency	:	Annamalai Univ., VCRC, Pondichery & NLC
5.	Project Leader/Project Co-Ordinator	:	Shri V. Manoharan, Chief Manager (Sci/CARD/NLC/ Dr.P. Narayanasamy, Prof. Head, Deptt of Entomology (AMU)/ Dr. P Jambulingam, Scientist F/VC RC, Pondichery.
6.	Total Approved Cost	:	Rs. 304.92 Lakh S&T Grant : Rs. 275.377 Lakh For NLC : Rs. 131.737 Lakh For AMU : Rs. 89.82 Lakh For VCRC : Rs. 53.82 Lakh Cont NLC : Rs. 29.543 Lakh

DESCRIPTION OF THE PROJECT

7. Objectives :

- To standardize methods to develop fly ash based pesticides.
- To formulate fly ash " 100% dust insecticides".
- To develop "herbal fly ash insecticides".
- To develop "Mirobial fly ash insecticides".
- To develop and test bio-logical fly ash pesticides against mosquitoes.
- To test the fly ash based pesticides against pest problems in rice, qroundnut, sugarcane, vegetables, cotton & pulses and in store godowns.
- To assess pesticides, residues in plant products, produce soil and water samples.

8. Status as on 31.03.2010 :

(i) **CARD / NLC :** As per the project schedule, pesticide residue survey in and around Neyveli - water bodies, aquifer, soil and plant samples completed in association with AU. The analysis of soil and water samples showed no residues of pesticide.

(ii) **Annamalai University :** Procurement of equipments and setting up of pilot plant were completed and production of fly ash based pesticides was continued. So far 158.1 kg of fly ash

based pesticides were produced consisting of different micron sizes. Production and evaluation of 10 herbal flyash based pesticides against different crop pests were in progress. Pest surveillance in certain parts of Cuddalore District was carried out at fortnight intervals. Data regarding the pest incidence were recorded. Hi-Tech green house construction was completed and commissioned. Collection of soil samples from certain points in Cuddalore district and its analysis were carried out.

(iii) **VCRC:** Water dispersible powder (WDP) formulations were prepared and the best one was taken-up for laboratory evaluation, testing on non-target organisms. This formulation was evaluated in small-scale field trials, cesspits in and around Puducherry. Mammalian toxicity studies for the WDP formulation (VCRC FA/B17) were conducted by International Institute of Biotechnology and Toxicology (IIBAT), Padappai, Chennai. The results showed that VCRC FA/B17 WDP formulation was non-toxic, non-virulent and non-irritant to mammals. A second type of formulation namely slow release formulation - Briquettes were developed using fly ash in different shapes and evaluation is in progress. The results are encouraging. It is proposed to prepare briquettes, pellets and granules for different applications.

(iv) Joint survey, soil and water samples collected by CARD & AU in and around Neyveli on 07.03.2009 at 8 locations were analyzed.

(v) Field experiments on groundnut completed; in fly ash applied plots no pest incidence was observed.

(vi) **Digital Image Recorder :** Installation and commissioning completed on 12.10.2009. By using this equipment, digital images of biopesticide Bacillus thuringiensis cells, spores and crystals were recorded. Poly green house- pot culture experiment with bhendi and shade house trials with brinjal and tomato were also recorded using Digital image recorder.

(vii) Pest incidence and the insect's response to fly ash trial on Bhendi crop grown in Poly green house were recorded. However, there was no pest occurrence during the season except mealy bug attack at the fag end of the crop growth. Mealy bug reacted to fly ash dusting by slight movement but persistent to the crops.

(viii) **Pilot plant trial studies :** Mass production of Bacillus thuringiensis var. israelensis was carried out in fermentor at CARD/NLC in association with VCRC and checked for spore formation properties.

(ix) Fly ash briquettes, pellets with fly ash prepared using varying composition in association with VCRC at CARD.

(x) Regarding purchase of Scanning Electronic Microscope, supply order was issued to M/s JEOL ASIA PTE LTD, Singapore on 02.03.2010.the firm has to supply and install the equipment before 30th June 2010.

(xi) Pest incidence and the insects' response to fly ash dusting on trial crops like brinjal and tomato in micro plot were completed and observations recorded. It was observed that there was no pest incidence in the fly ash dusted brinjal and tomato. Where as the control plot was found infested with pests like Epilachna beetle, whitefly, shoot and fruit borer.

(xii) In shade house ginger crop with different treatments like fly ash soil application, dusting, humic acid slurry soil application, and humic acid dipping of rhizome is under progress.

(xiii) In poly green house crops like ragi, green manure and cocks comb were raised for studying pest incidence and testing of fly ash formulations.

(xiv) Bio-pesticides efficiency and dosing evaluation demo was organized at VCRC, Pudhucherry. The project staff of NLC - Health dept & CARD personnel had undergone training for a period of one week.

9. Slippage, if any : Nil

10. Action Plan for 2010-11 :

Sl. No.	Activity	Date of start	Date of completion
1.	Coordinating in the conduct of lab & field experiments involving flyash based pesticides in field crops & mosquitos	Continued from first year	Jul 2010
2.	Co-coordinating with Health / TA /AU/ VCRC for study pest / mosquito control	From 2nd quarter of 2008	Dec 2010
3.	Report preparation	Dec 2010	Apr 2010

1.	**Name of the Project**	:	**Development of methodology for estimation of Greenhouse Gas Emissions (GHG) in mine fire areas and their mitigation through terrestrial sequestration.**
2.	Date of start	:	Feb 2009
3.	Scheduled date of completion	:	Jan 2012
4.	Implementing Agency	:	Central Institute of Mining & Fuel Research, Dhanbad
5.	Sub-Implementing Agency	:	Department of Botany, Banaras Hindu University, Varanasi
6.	Project Leader	:	Dr. Siddarth Singh, Scientist
7.	Project Co-ordinators	:	Dr. A. K. Singh, Scientist Dr. B. K. Tewary, Scientist
8.	Total Approved Cost	:	Rs. 341.77 Lakh

DESCRIPTION OF THE PROJECT

9. Objectives :

(i) To estimate Greenhouse Gases (CO_2, CH_4 & N_2O) emission from coal mine fire areas, inventorization and its temporal and spatial dispersion at ground level.

(ii) To estimate in real time the load of combustion aerosol (black carbon, sulphates and nitrate) emissions from mine fire area.

(iii) To quantify the existing greenhouse gases sinks using space born data and estimate its carbon sequestration potential.

(iv) To develop GHG's Emission Factor for coal mine fires.

(v) To standardize terrestrial CO_2 sink management practices under Landuse, Landuse Change and Forestry and facilitate future emission trading.

10. Status as on 31.03.2010 :

- **Development of Monitoring Protocol**

Detail literature survey has been done to develop the monitoring protocol for collection and measurement of gas samples at both the sites. Considering the approved methodology it has been planned to go for upwind and downwind sampling and subsequent analysis on Gas Chromatograph in the laboratory.

- **Recruitment of Project Staff**

For the recruitment of project staff advertisement has been made in the Employment News and other news papers in February 2009. More than two hundred application forms were received among which five candidates were selected and engaged.

- **Procurement of Instruments**

Extensive literature survey has been done to collect information regarding the best available technology to be implemented in the project. Detailed information has been collected from the personal communication to the manufacturers and users of instruments in India and abroad. Visits have been made to few advance research labs to see the working of latest analytical and measurement techniques. Indents for procurement of approved instruments were finalized obeying the CSIR Purchase Rule and submitted to the purchase department.

Present status of the procurement is as follows :

- Most of the indents are in the order stage.
- So far two approved Software have been installed.
- Purchase Order for Gas Chromatograph has been released on 22nd June 2010.

Recruitment of consultants for the preparation of CDM Proposal (Carbon Credit) : Extensive survey has been done to prepare a panel of consultants of very high reputation and success record. Enquiry has been issued and response is awaited.

Base line data generation for CDM Project/Carbon Credit : One of the very important perquisites for approval of CDM Proposal is the availability of baseline data for various environmental components to compare for the increment in the carbon storage.

For terrestrial carbon sequestration projects it very important to have baseline soil carbon status and other properties like soil texture, particle size, bulk density, WHC and chemical parameters like pH, EC, OC, OM, and nutrients. Several soil samples representing wasteland, agriculture land and forest land have been analyzed from the study area

Total mass (percentage) of soil in each sieve size fraction:

- mm, >1 mm, >0.5 mm, >0.25 mm, >0.125 mm, >0.075 mm, >0.062 mm and <0.062 mm was found as 16.49%, 16.28%, 21.16%, 15.19%, 15.47%, 6.25%, 3.36%, and 5.03% respectively in Salanpur & Mugma areas of Raniganj Coalfield.
- Majority of soil samples were classified as Sandy Loam.
- The average bulk density of soil was recorded as 1.26 gm/cm-3.
- Average porosity value of 38.37 % was found in the study area.
- Average WHC has been found as 32.3%.
- Average pH of soil varies from 5.2 – 7.6.
- The conductivity ranges from 80 -517μmhos/cm, and average EC value was 230.5 μmhos/cm.
- Soil organic carbon status of the study area in Jharia and Raniganj coalfields have been found in the range of 0.13% to 1.18% showing considerable sequestration potential.
- Organic Matter has been found in the range of 0.23 to 1.91%.
- Available phosphorus has been found in the range of 5.05 kg/ha.
- Average Calcium (0.052 mg/g), Magnesium (0.039 mg/g), Sodium (0.079 mg/g) and potassium (0.042 mg/g) were also estimated.

11. Slippage, if any

Delay in procurement of equipment and related aspects

12. Detailed Action Plan for 2010-11:

Sl. No.	Activity	Date of start	Date of completion
1.	Visit to mines for monitoring at sampling sites for emissions from mine fire	Apr 2009	Apr 2010
2.	Installation of CO_2 analyzer	May 2010	Jun 2010
3.	Collection of soil samples and their analysis	Jul 2010	Sep 2010
4.	Field investigation, collection of date and experimentation & laboratory study and preparation of carbon credit project	Oct 2010	to be continued

Field : Environment & Ecology — Project Code : EE/40

1.	**Name of the Project**	:	**Carbon sequestration in revegetated coal mine wastelands.**
2.	Date of start	:	Feb 2009
3.	Scheduled date of completion	:	Jan 2012
4.	Implementing Agency	:	Central Institute of Mining & Fuel Research, Dhanbad
5.	Project Leader	:	Dr. Raj Shekhar Singh
6.	Project Co-Ordinator	:	Dr. B. K. Tewary
7.	Total Approved Cost	:	Rs. 64.76 Lakh

DESCRIPTION OF THE PROJECT

8. Objectives :

- To quantify the carbon storage in soils of different aged revegetated mine spoils.
- To estimate the carbon storage by different plant species in revegetated mine spoils along an age gradient.
- To explore the amount of soil biomass carbon in diferent aged mine spoils.
- Estimation of carbon in different component of plants of revegetated mine spoils.
- To estimate the carbon storage and flux potential of the revegetated mine spoils.

9. Status as on 31.03.2010 :

Standardization of methods for physico chemical analysis of soil has been done. The purchase process of rotary shaker, deep freezer and CHN analyzer is in progress. Sample Collection and physico chemical characterization of soil samples from NCL sites and Mugma sites have been done for winter season. Estimation of plant growth in terms of height and girth in revegetated mine site has been done. Leaf litter from NCL and Mugma site has been collected from above ground. Biomass study and process started.

10. Slippage, if any : Nil

11. Detailed Action Plan for 2010-11

Sl. No.	Activity	Date of start	Date of completion
1.	Monitoring of plant growth (height & growth)	Continuing	Aug 2011
2.	Collection of plant root and soil samples	Continuing	Aug 2011
3.	Chemical analysis of plant, soil and carbon storage and flux studies	Sep 2010	Aug 2011

Field : Environment & Ecology — Project Code : EE/41

1.	**Name of the Project**	:	**Treatment of acid mine water generated in Indian coal mines using low cost material.**
2.	Date of start	:	Jan 2010
3.	Scheduled date of completion	:	Dec 2012
4.	Implementing Agency	:	CIMFR, Dhanbad
5.	Project Leader/Co-Ordinator	:	Dr. (Mrs) B. Prasad /Dr. B K Tewary
6.	Total Approved Cost	:	Rs. 44.17 Lakh

DESCRIPTION OF THE PROJECT

7. Objectives :

- Characterization of acid mine water of few Indian coal mines (underground and opencast)
- Conversion of fly ash in to zeolitic mineral to be used for treatment of acid mine water.
- Treatment of acid mine water by fly ash zeolites.
- Evaluation of effectiveness and cost for treatment of acid mine water by fly ash zeolite.

8. Status as on 31.03.2010 :

Purchase of equipment is in progress. Planning for Collection of AMD is in progress

10. Slippage, if any : Nil

11. Detailed Action Plan for 2010-11 :

Sl. No.	Activity	Date of start	Date of completion
1.	Purchase of equipment	Continuing	Jun 2010
2.	Collection of Acid mine drainage	Continuing	Jun 2010
3.	Collection of fly ash and preparation of zeolite	Jul 2010	Dec 2010
4.	Structured determination of FAZ	Sep 2010	Jun 2011

Field : Environment & Ecology — Project Code : EE/42

1.	**Name of the Project**	:	**Emissions from coal based industries – development of predictive models.**
2.	Date of start	:	Jan 2010
3.	Scheduled date of completion	:	Dec 2012
4.	Implementing Agency	:	NEIST, Jorhat
5.	a. Project Leader	:	Dr. Puja Khare, Scientist, NEIST, Jorhat
	b. Project Co-Ordinator	:	Mr. B.P. Baruah, Head , Coal Chemistry Divn NEIST, Jorhat
6.	Total Approved Cost	:	Rs. 82.46 Lakh

DESCRIPTION OF THE PROJECT

7. Objectives :

- To quantify the particulate matter (SPM, PM2.5 and PM10) and toxic gas emissions from coal mining and utilization industries.
- Chemical characterization and mass size distribution of particulate matter (PM 2.5 and PM 10) from coal based industries.
- Evolving relationship between the coal quality parameters emissions.
- Identification of the factors that contribute towards emission of particulates (SPM, PM2.5 and PM10) and toxic gases depending upon the type of mining methodologies and utilization techniques.
- Emission inventory for coal based industries.
- Modeling and suggestive measures to regulate the emission from coal from coal mining and utilization industries like coke ovens, mining etc.

8. Status as on 31.03.2010 :

Procurement of PM 2.5, PM 10 and SPM samplers are in process. Coke oven site selected. Search on emissions from coal based industries, aerosol and gaseous formation and relationship between emission and coal characteristics are in progress.

10. Slippage, if any : Nil

11. Detailed Action Plan for 2010-11

Sl. No.	Activity	Date of start	Date of completion
1.	Site selection and procurement of equipment	Continuing	Mar 2011
2.	Sample Collection analysis	Continuing	Mar 2012
3.	Emission of estimate for emission inventory	Dec 2010	Oct 2011

S&T Completed Projects during 2009-10

S&T Annual Report

2009-10

1.	**Name of the Project**	:	**Indigenous development of prototype longwall support (chock- shield)**
2.	Implementing Agency	:	Singareni Collieries Company Ltd., Kothagudum
3.	Sub-implementing Agency	:	APHMEL, Vijayawada
4.	Project Leader/co-ordinator	:	Director (Operation), SCCL, and MD, APHMEL, Kondapalli
5.	Date of Start	:	Aug 2004
6.	Date of Completion	:	Aug 2009
7.	Total Approved Cost	:	Rs. 228.47 Lakh S&T Grant- 197.97 Lakh Contribution SCCL - Rs. 30 .50 Lakh.

DESCRIPTION OF THE PROJECT

8. Objectives :

(i) Developing and manufacturing of indigenous chock shields of adequate capacity and compatible with Indian Geo-mining conditions.

(ii) To bring down the cost component of powered roof support to about 50% of the imported cost (The cost of chock shields from nearly 50-60% of the total cost of imported Long wall equipment for a 150m face length).

9. Work Done :

(i) To contact reputed institutions for study on support density requirement in SCCL

(ii) To establish strategic alliance with a reputed manufacturing agency having capability and technical expertise to design, develop drawings and manufacture the chock shields.

(iii) To analyse the structural design of the developed drawings of the chock shields by the strategic alliance partner by reputed academic and /or research institutes and incorporate the suggestions made for design modification.

(iv) To submit 1 chock shield to Integrated Testing Facility (ITF) at Jessop & Co to undergo the necessary life cycle testing as per ICIS-001/1991 and DGMS guidelines /stipulations.

(v) To experiment/test the chock shields in a running longwall face for evaluating their working performance in the field conditions.

10. Findings :

SCCL in association with APHMEL, Vijaywada has developed four legged proto-type chock shield of 4 x 800 T for operating height range from 2.3 m (close) to 3.5 (Extended). The support density is around 140 T/m^2.

The support unit was subjected to various tests related to structural & hydraulics at ITF, Jessops, Kolkata as per DGMS norms. Finally, the support has passed all the tests successfully.

It is observed from the cost analysis that a cost of imported support (M/s Joy Mining India Limited) having same capacity of 800 T is around Rs. 1.08 Cr, whereas this indigenously developed support unit cost avound Rs. 53 lakh i.e. around 49% of the imported. The cost can further be brought down to Rs. 43 lakh per unit if high tensile steel plate having yield strength of 450 MPa will be made available indigenously by the Indian Steel Manufacturers, as stated in the report.

1.	**Name of the Project**	:	**Development of a micro seismic monitoring system for stability analysis of underground mine workings under "Difficult to cave" roof conditions**
2.	Implementing Agency	:	CIMFR & ECL
3.	Project Leader/Co-ordinator	:	Dr. Gautam Banerjee, Scientist, CIMFR
4.	Date of Start	:	Oct 2004
5.	Date of Completion	:	Sep 2009
6.	Total Approved Cost	:	Rs. 47.849 Lakh

DESCRIPTION OF THE PROJECT

7. Objective :

(i) To develop a scientific method of mining areas being worked under "Difficult to Cave" roof conditions.

(ii) To assess the efficacy of stabilization in the areas where mining was done long back.

8. Work Done :

Microseismic monitoring study has been undertaken to locate unstable zones with high stress concentration within the rock mass and quantify the magnitude of seismicity over the excavated panels in various collieries of Eastern Coalfields Limited. The stability in these areas was a suspect and prone to unforeseen subsidence.

The study was conducted at 5 locations under varying geo-mining conditions as given below:

(i) Chora 10 Pit Colliery-Site 1, Kenda Area: over a running B&P panel being extracted alongwith hydraulic sand stowing

(ii) Chora 10 Pit Colliery-Site 2, Kenda Area: over already worked out BG panels

(iii) Porascole Colliery, Kajora Area: over panels already worked out by Yield Pillar technique

(iv) Jhanjra Project: over a running Longwall panel where regular subsidence was occurring.

(v) Ratibati Colliery: over a new panel where development had just started along few headings having unknown workings in the overlying seams.

The main emphasis of the project was to develop a scientific expertise and approach to assess and quantify the degree of instability over worked out mining areas especially in subsidence prone mining areas of Raniganj Coalfields.

At each location, six numbers of uniaxial geophone sensors were installed over the study area and the microseismic events were recorded by the data acquisition system. The P-wave velocity for each location was determined from the trial blasts conducted at known locations. This velocity was used to process the events to determine different event parameters.

(i) The P-wave velocity was found to be 2886.8 m/s at Chora, 2658.4 m/s at Porascole. At Jhanjra, the P wave velocity was observed to be low i.e. 2145.2 m/s probably because of the presence of goaf in the overlying workings of R VII seam. The average value of P-wave velocity = 2773 m/s can be taken for intact rock condition at Raniganj coalfields.

(ii) Micro-seismic monitoring reveals that during disturbances in the overlying strata micro-seismic emission rate reaches a peak and when ground motion ceases, micro-seismic emission rate drops to a relatively low level. At Jhanjra the average two hourly event count of 12 was found to be maximum. It was followed by Porascole where 7 events were recorded at two hours interval. The minimum value of 1 was observed at Chora – Site1. This indicates that with respect to event count Jhanjra is most unstable where as Chora - Site1 site is most stable among these five locations. Thus the two hourly event counts can be used to quantify the degree of instability of overlying strata.

(iii) The micro-seismic energy coefficient c_2 influences the energy released due to particular event. For the same magnitude the more unstable area will release more energy compared to a stable area. The maximum value of c_2 was 1.46 at Jhanjra where as at Chora - Site2 and Ratibati c_2 was 1.4. The minimum value of c_2=1.29 was obtained at Chora - Site1. The variation in this parameter is not significant. But this parameter will influence the total energy released for a number of events within a small span and increased duration of events.

(iv) The other parameter, seismic moment also quantifies the rock mass stability around underground mine workings. The Moment Index, MI is calculated as the sum of seismic moments over a time interval of 12 minutes within a given volume. The maximum moment index observed over an interval at any site is more in case of unstable area. At Jhanjra the value of maximum moment index was found to be 4.5e+8 Nm which is maximum among the 5 locations. At Porascole the maximum moment index was found to be 2.3e+8 Nm. The minimum value of 1.4e+8 Nm was obtained at Chora - Site1. Thus the maximum moment index can also be used to quantify the degree of instability of overlying strata.

(v) The combined effect of all the three microseismic parameters have been used to develop a Specific Instability criterion to quantify the degree of instability.

(vi) The Specific Instability, *SI* is defined as

vii. $$SI = \frac{n \times c_2 \times MI_{max}}{1440000}$$

(viii) Where, n = average two hourly event count

c_2 = seismic energy coefficient

MI_{max} = maximum seismic moment index

(ix) The specific instability has been determined for different locations and the stability condition has been assessed based on this value.

(x) The value of specific instability was found to be maximum at Jhanjra as the study was conducted over a running Longwall panel where regular subsidence at the surface was observed. Regular falls in the goaf were occurring during the face operation. Therefore, the strata at Jhanjra site was categorized as unstable. At Chora-Site1 where a running B&P panel was being extracted along with hydraulic sand stowing, the specific instability was found to be minimum. The site exhibited stable strata condition and also proves the efficacy of hydraulic sand stowing. The values of specific instability at three previously worked unknown locations, i.e. Chora-Site2, Porascole and Ratibati were also low suggesting them to be under stable condition.

(xi) Microseismic monitoring technique has been found to be an effective technique for assessment of degree of instability of any unknown mined out locale and efficacy of measures undertaken for underground stabilization. However it is recommended that this study should be extended to more areas with known mining conditions to prepare a comprehensive scale based on which the stability of an unknown excavated area can be assessed.

1.	**Name of the Project**	:	**Characterization of rock and explosive parameter for optimal explosive energy utilization in opencast blasting.**
2.	Implementing Agency	:	CIMFR & CMPDI
3.	Project Leader/ Co-ordinator	:	DR. A. K. Jha/Shri D. Basu, CMPDI
4.	Date of Start	:	Apr 2005
5.	Date of Completion	:	Mar 2010
6.	Total Approved Cost	:	Rs. 270.37 Lakh For CMPDI – Rs. 206.15 lakh For CIMFR – Rs. 64.22 lakh

DESCRIPTION OF THE PROJECT

7. Objectives :

The aim of the project was to formulate guidelines for selection of suitable explosives for different rock mass characteristics. The work was executed in six opencast mines, namely, Sonepur Bazari project of ECL, Kusmunda project of SECL, Jayant project of NCL, Umrer project of WCL and Mine I & II of Neyveli Lignite Corporation.

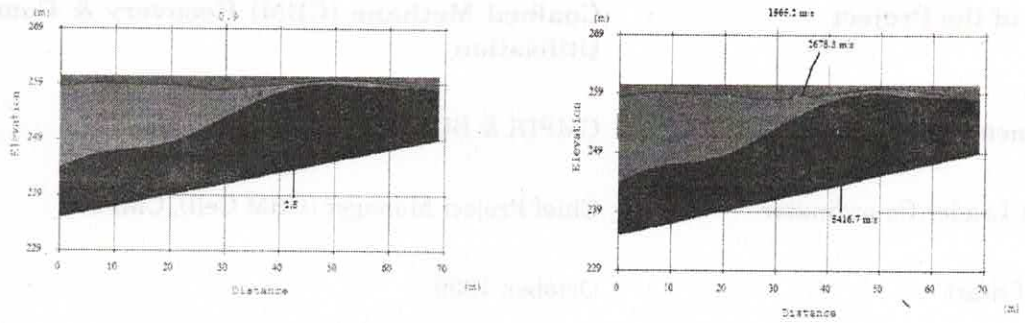
8. Work Done & Findings :

The findings of this project are significantly important for understanding the synergistic approach of rock-explosives interactions for achieving optimal explosives energy utilisation in opencast mines by selecting suitable explosives for any rock mass.

Presently, all the mines of CIL are using bulk explosives with the uniform velocity of detonation (VOD) range of 3500-4500 m/s irrespective of wide variations in rock mass in all subsidiaries of Coal India Limited without proper judgement of consequences of important parameters like significant change in detonation pressure and energy release and energy release rate in a charged borehole due to change in VOD. The classification of rock mass developed under the project with due consideration of soft, medium hard and hard formations and their seismic velocities had prompted to select suitable explosives on the basis of matching the explosive impedance with rock impedance. The selection of explosives on the basis of matching the rock and explosive impedance will improve the blast performance with improved blast fragmentation, productivity, energy utilisation, mine economics and reduced environmental impacts viz. vibration, fly rock, air over pressure and noise. The developed rock mass classification on the basis of seismic velocity vis-a-vis minimum VOD requirement for achieving optimum fragmentation is tabulated below.

Type of rock mass formation	Seismic (P- Wave) velocity range (m/s)	In-the-hole VOD of explosives range (m/s)
Soft formation	500 - 1500	3000±150
Medium hard formation	1500-2200	4000±200
Hard formation	> 2200	5000±250

A typical seismic wave plot showing the various clusters of rock mass at Umrer project, WCL alongwith minimum VOD requirement for achieving rock fragmentation is shown below.



(ii) At present, the explosive charge per delay is controlled by adopting deck charged blasting so as to reduce induced ground vibration. The decking height is decided solely on the basis of personal experiences or judgement without adopting any scientific yardstick for deciding the minimum deck height. It was observed from the study that if minimum deck height is not optimum technically than all the explosive deck charges gets blasted simultaneously against designed delay interval i.e. inter deck, inter hole and inter row delay interval. Under such situations, the ground vibration and other blast related environmental nuisances increases significantly affecting the mine productivity and economics. It was found that optimal deck thickness between decked explosives columns to obviate any chance of occurrences of pressure desensitisation inside a borehole may be approximated to 10 D and the cast booster should be positioned at a distance of 4D from the floor of the blast hole, where D refers to blast hole diameter in mm.

(iii) This study is first of its kind in the country with special reference to determination of dynamic tensile strength for improved fragmentation. During blasting process, the rock mass is subjected to a very high dynamic loading due to explosives and the dynamic properties of rock mass plays pivotal role in fracture mechanism as compared to static rock mass properties. Till date, only static rock mass properties are considered for determining rock fragmentation. Under this project, the dynamic properties of rock mass was determined by Split Hopkinson Bar Technique (SHPB) for Indian sandstone, shale and coal samples. It was found that the dynamic tensile strength of Indian coal samples to be 1.5 times higher than the static tensile strength with increasing blast induced dynamic load whereas, the dynamic tensile strength of Indian sandstone was found to be 3 times higher than static tensile strength with increasing dynamic load. This finding will help in choosing the suitable explosive for improved post blast results by increase in energy utilisation and fragmentation.

(iv) The recent practices in majority of opencast mines is to adopt the practice of multi point priming instead of single point priming. The multi point priming has time and cost disadvantages as compared to single point priming. Under the project, it was found that the explosives column under 10 m can be safely initiated by single point priming i.e. concentrated booster priming instead of multiple point priming. This would add time and cost advantages to the operating mines of CIL. Further, the study revealed that when the explosives density reaches the dead pressed density i.e. 1.25-1.30 g/cc, it no longer behaves like an explosives as the detonation characteristics changes to deflagration characteristics. The viscosity of an emulsion matrix for high energy release should be between 40000 cps to 80000 cps.

1.	**Name of the Project**	:	**Coalbed Methane (CBM) Recovery & Commercial Utilisation**
2.	Implementing Agency	:	CMPDI & BCCL
3.	Project Leader/Co-ordinator	:	Chief Project Manager (CBM Cell), CMPDI
4.	Date of Start	:	October, 1999
5.	Date of Completion	:	December, 2009
6.	Total Approved Cost	:	Rs.9242.70 Lakh
	:		UNDP/GEF – Rs.4143.70 Lakh
			UNDP/India – Rs.545.10 Lakh
			ONGC Co-sharing – Rs.1215.70 Lakh
			GOI (Cash) S&T Grant – Rs.1805.80 Lakh
			GOI (kind) – Rs.699.40 Lakh
			Part of the Revenue – Rs. 833.0 Lakh
			Cost met out of the income generated from the project.

DESCRIPTION OF THE PROJECT

7. Objectives :

To degasify coal seams for safer extraction of coal and to demonstrate economic viability of harnessing Coal Bed Methane in India.

8. Work Done :

The project has acquired suitable infrastructure like heavy duty high-tech drilling rig unit and other equipment required for taking up CBM related large diameter deep drilling. The associated personnel are trained, experienced and geared-up to take up CBM well completion job in suitable areas.

Three vertical CBM wells have been drilled and recovery of gas from two wells has been established and other activities are underway to recover gas from the third well. Efforts are being made to drill more vertical production wells to supplement additional gas recovery.

Details of coal seams encountered and targeted for CBM production in the three vertical wells are as hereunder:

Seam	1st well		2nd Well		3rd Well	
	Roof Depth (m)	Thickness (m)	Roof Depth (m)	Thickness (m)	Roof Depth (m)	Thickness (m)
XVIII	538.90	4.6 (J+MP)	532.80	3.5 (J+MP+C+J)	468.41	3.52 (J+MP)
XVII Top	**594.40**	***1.80 (C)***	**588.30**	***2.10 (C+J+M+C)***	523.23	1.84 (C)
XVII Bot	632.65	1.10(SC)	612.05	1.55	552.57	1.34
XVI Top	**733.77**	***5.12 (C+J)***	725.50	6.1(J)	666.37	6.14(J+MP)
XVI Bot	747.10	0.90	740.20	1.40	681.49	0.98 (L5)
XV Top	**879.70**	***4.0 (C)***	**867.70**	***4.2 (C)***	**802.69**	***3.88 (C)***
XV Bot	**884.70**	***5.45 (C)***	**872.60**	***5.05 (C)***	**807.71**	***4.87 (C)***
XIV	951.40	10.45 (J+MP)	951.00	8.10 (J)	878.69	14.46 (J+MP)
XIII	965.85	12.80 (J+MP)	963.35	13.55 (J+MP)	897.73	8.48 (J+MP)
XII			**1016.25**	***5.75 (C)***	**940.21**	***5.50 (C)***
XI			1036.15	9.80 (J+MP)	957.01	9.32 (J+MP)
X					**1006.03**	***7.62 (C)***
Closing Depth		1059.30		1071.30m		1108.40m

Note: Seams indicated with bold letters and italics have been subjected to hydro-fracturing

Hydro-fracturing is a process developed by the oil industry for increasing productivity of a reservoir. Three potential coal seams in three wells were hydro-fractured and stimulation data are tabulated as hereunder:

Seam	Depth Interval (m)	Thickness (m)	Perforation Interval (m)	Maximum Pressure (psi)	Proppant Pumped (tonne)	Fluid Pumped (BBL)
1st CBM Well						
XVIIT	594.40-596.20	1.80	595.10-596.10	2383	40	1145
XVIT	733.77-738.90	5.12 C+J+C+J	734.50-736.50	1540	40	847
XVT & XVB	879.70-883.70 884.70-890.15	4.00 5.45	881.50-883.50 886.60-889.00	3855	52	1000
2nd CBM Well						
XVIIT	588.30-590.40	2.10 C+J+C+M P	588.40-589.50& 589.90-590.40	2763	40	979
XVT & XVB	867.70-871.90 872.60-877.65	4.20 5.05	874.40-877.40	4858	47	950
XII	1016.25-1022.00	5.75	1020.0-1022.0	2253	45	1050
3rd CBM Well						
XVT & XVB	802.69-806.57 807.71-812.57	3.88 4.87	805.50-806.50 810.50-812.50	4300	35	1325
XII	940.21-945.71	5.50	943.60-945.60	4300	46	1200
X	1006.03-1013.65	7.62	1010.50-1013.50	1200	58	1330

Under R&D efforts, this demonstration project has been successfully implemented at Moonidih coal mine of BCCL in Jharia Coalfield. This project is a path finder for coal mine methane development in Indian mining scenario as methane gas embedded in coal seams have been successfully recovered through vertical wells on surface and the recovered gas is being used as fuel in gas-based generators for electricity generation since 27th June, 2008. Total 10,65,857 kwh of electricity has been generated whereas 5,53,042 kwh has been generated during 2009-10 alone, the generated electricity is being supplied for domestic use in Moonidih project colony.

Fourth vertical well site preparation is nearly completed. The balance of available fund will be utilized for drilling, completion and recovery related activities to provide additional gas to meet the requirement to run the gas based generators, round the clock, for electricity generation.

India CMM/CBM clearing house is functioning in collaboration with USEPA since 18th November, 2008 at CMPDI (HQ), Ranchi and a website (www.cmmclearinghouse.cmpdi.co.in) has been created E-library is also functional towards dissemination of information.

Capacity of the Coal India Limited (CIL) Subsidiaries namely CMPDI and BCCL has been strengthened including the capability in recovery of CBM/CMM through vertical wells. For this purpose equipment for drilling of vertical wells has been procured. After drilling of wells, cementation of wells in two stages was done after geophysical logging. The specialized geophysical logging (hired services) following by perforation (hired services) and hydro-fracturing was conducted in the three production wells.

9. Findings

This unique and high technology demonstration project was successfully implemented at Moonidih project of BCCL. The recovered gas site is almost 98% pure methane which is being utilized to run gas based generators at Moonidih Colliery, BCCL and the electricity generated is being supplied to the Moonidih residential colony.

The project has created enough awareness in the Indian coal mining industry and the industry is now at a threshold of replicating such projects in other suitable areas. The project will open a new era in harnessing and utilization technique of coal mine methane, which is otherwise a wasted clean energy resource. This project proves the efficacy of the technology for CMM extraction and its utilization in Indian scenario.

Field : Production, Productivity & Safety — Project Code : CE/28

1.	**Name of the Project**	:	Hydrogeological studies for control or ground water for safe and economic mining of Lignite Deposits in Nagaur district of Rajasthan.
2.	Implementing Agency	:	Rajasthan State Mines and Minerals Ltd. (RSMML), Udaipur
3.	Project Leader/Co-ordinator	:	Shri Harsh Vardan, Sr. Manager (Geology)
4.	Date of Start	:	May 2007
5.	Date of Completion	:	Mar 2010
6.	Total Approved Cost	:	Rs.182. 12 Lakh S&T Grant - Rs. 145.696 Lakh Cont. RSMML - Rs. 36.424 Lakh

DESCRIPTION OF THE PROJECT

7. Objectives :

- Detailed evaluation of groundwater potential of water bearing horizons associated with lignite deposits. Methods and extent of ground water control operations for safe and economic mining of lignite deposits
- Estimation of static and dynamic ground water reserves and yield potential for 25 years
- Effect of pumping on water quality in long run and probable change in underground Water balance
- Assessing the full economic impact of groundwater management for mining lignite resource in the area.
- Environmental impact assessment of lignite mining arising out of groundwater control operations.

8. Work Done :

(a) Field Studies

- Hydro-meteorological data collection
- Well inventory and establishing monitoring networks of hydrograph stations and their periodic monitoring

(b) Laboratory Studies

The pump test data analysis is to be carried out to establish the aquifer parameters. The chemical analysis of ground water samples will be carried out to know the quality of water at different localities in the study area.

(c) Analysis of data :

(i) A mathematical model based on regional hydro-geological study for predicting changes in ground water regime with depressurization of confined aquifer for lignite mining.

(ii) Estimation of static and dynamic ground water reserves for coming 25 years.

(iii) Effect of pumping on water quality in long run and probable change in underground water balance.

(iv) Ground water management for economic exploitation of lignite and ground water management techniques with reference to lignite mining in the study area.

9. Findings :

(i) Two district ground water horizons have been identified and their spatial distribution has been established. The aquifer parameters from these horizons have been determined by pump tests. Methods for ground water control operations for safe are economic mining of Lignite deposits have been devised.

(ii) The static ground water reserves upto 220 MRL are 1750.7 million cubic meters. The dynamic ground water reserves of different formations in Jayal block are ranging from 4.17 million cubic meter to 13.79 million cubic meter.

(iii) The probable change in the ground water balance is being assessed by National Institute of Hydrogeology, Roorkee by carrying out ground water modelling.

(iv) The full economic impact of ground water management for mining Lignite reserves in the area has been assessed.

Field : Coal Utilisation — Project Code : CU/48

1.	**Name of the Project**	:	**Agglomeration formation in reducing condition in pressurised fluidised bed gasification (PFBG) with low rank high ash Coals.**
2.	Implementing Agency	:	CIMFR, CET, Osmania University & CMPDI
3.	Project Leader/Co-ordinator	:	Shri S. Dutta & Shri B. K. Mali, Scientist, CIMFR Shri K. Basu, Adviser, CET, Osmania University, Hyderabad GM (CT), CMPDI
4.	Date of start	:	Nov 2003
5.	Date of Completion	:	Sep 2009
6.	Total Approved Cost	:	Rs. 338.58 Lakh CIMFR – Rs. 283.48 Lakh CET, Osmania Uni - Rs. 42.71 Lakh CMPDI – Rs. 12.39 Lakh

DESCRIPTION OF THE PROJECT

7. Objectives :

- Validation of Reactivity of various coals under reducing conditions
- Mechanism of aggglomerate and clinker formation, under pressure and in reducing atmosphere due to coal properies and reactor design, and
- Mechanism of elutriation with different ash content (different coals)

8. Work Done :

(a) Installation and commissioning of PFBG unit at CIMFR

(b) Characterization of different coals

(i) Proximate and Ultimate Analysis, CV determination etc.

(ii) Validation of Reactivity

(c) Experimentation with different coals

(d) Mathematical Modeling of the process

(e) Validation of the mathematical model

9. Findings :

Presently coal utilization technologies are suffering from huge environmental threats, Major R&D thrust is on the development of environmental friendly and economically competitive alternatives compared to the conventional power generation technologies. Coal gasification is the most promising technology will continue to play a vital role in coal utilization for production of liquid fuels, chemical feed stock and power through combined cycles,. Hence, coal gasification appears to be a technology of commercial importance.

Due to high ash content and high reactivity of Indian coals, there is a tendency of agglomerate formation. Uncontrolled agglomeration causes de-fluidization of the bed and leads to the process failure. The agglomeration in the fluidized bed depends upon gasification parameters and coal properties. So, it is required to study the effect of coal properties and operating parameters on agglomerate formation before scaling up or commercialization of PFBG technology.

To fulfill the objective of the project a pressurized fluidized bed gasification (PFBG) test facility having capacity of 20 kg/h coal feed rate has been installed at CIMFR Dhanbad.

In the present R&D work, a number of experiments were conducted with the three selected high ash Indian coals from different coalfields (namely Lingraj-MCL, Rajmahal-ECL and KDH-CCL) under varying operating conditions to find out their agglomeration behavior under reducing condition and suitability towards gasification. Based on our experimental study, all three coals were found suitable for gasification. However, in some of the experiments agglomeration was also observed with the selected coals due to improper fluidization or steam deficiency resulting in sudden rise of the temperature.

Further, it has been found that entrainment varies in the range of 800g/h to 1700 g/h. However, entrainment was much higher in case of Rajmahal coal due to its higher Hard Grove Index (HGI) value while for the other two coals HGI values and entrainment was more or less in the similar range. Thus, change in entrainment may be due to difference in HGI.

A suitable multivariable regression model has been developed to correlate coal properties and operating parameters with gas generation and heating values of the product gas and the same model has been validated with the data generated during the experiments in the PFBG test facility using the selected coals.

From findings of the present work, it may be stated that high ash Indian coals can be handled in better way in PFBG system without any operational trouble and environment friendly manner to generate synthesis gas which can be used for various applications such as power generation, generation of liquid fuels, various thermal applications. Further, it would not be out of space to mention here that this process is more suitable for high ash Indian coals due to good mixing and relatively low process temperature which prevents ash related problems. It is expected that this study will not only assist. Indian IGCC technology developers but also it could form the basis for suitable gasifier selection.

Field : Coal Beneficiation and Utilisation — Project Code : CU/53

1.	**Name of the Project**	:	**Pulse detonation combution of coal for energy application.**
2.	Implementing Agency	:	IISc, Banglore
3.	Project Leader/Co-ordinator	:	Prof. S. sheshadari
4.	Date of start	:	Mar 2008
5.	Date of Completion	:	Feb 2010
6.	Total Approved Cost	:	Rs. 22.60 Lakh

DESCRIPTION OF THE PROJECT

7. Objectives :

The program would focus on set up of a facility for Pulse Detonation Combustion of Coal. The research component will involve study of detonation structures in coal air mixtures and coal detonation chemical kinetics at high temperatures and pressures and diffusion processes.

8. Work Done :

(i) Detonation tube set - up was established at IISc, Bangalore

(ii) A compressor –receiver system capable of pressures up to 80 atmospheres was used from the diaphragm based shock wave initiation and ignition

(iii) Numerical and analytical modeling of the combustors was made the stimulate detonation initiation, reflection, scavenging and creation of an environment suitable for fresh coal particles and air to form a detonable mixture.

9. Findings :

The project has concluded that" pulse detonation combustion of coal" using constant volume of combustion instead of constant pressure combustion has shown about 15% increase in thermal efficiency with a combustion efficiency of nearly 100% and, as a result, about 10% increase can be expected in power generation with the same quantity of fuel consumption.

In second series of laboratory experiment, it was observed that fly ash zeolite liner is very much effective in completely removing total hardness, Ca hardness and Mg hardness from leachate of pond ash filled vat with liner. The geosynthetic fly ash zeolite liner is also effective in significantly reducing the concentration of chloride, sulphate and potassium in leachate water of pond ash filled vat with liner as compared to leachate water of pond ash filled vat without liner.

The leachate water of pond ash filled vat with liner showed a little higher pH and TDS as compared to leachate water of pond ash filled vat without liner. This is due to unreacted alkali present in fly ash zeolite, which leached out in leachate water responsible for higher pH and TDS.

Fly ash zeolite liner has not found effective in removing fluoride from leachate water of pond ash filled vat with liner. Almost similar concentration of fluoride ion has been found in the leachate water of both the vats.

Fly ash zeolite liner has been found very effective in reducing the concentrations of heavy metals like Fe, Zn, Cu, Mn, Pb, Ni, Cd and Cr in leachate water of pond ash filled vat. As such low and irregular concentration of heavy metals released in leachate water of pond ash throughout the study period. The leachate water of pond ash filled vat with liner even contained very low concentration of heavy metals due to presence of liner.

From the overall experiment, it has been found that all the fly ashes of seven major thermal power plants of India have been found suitable for zeolite preparation. Fly ash can easily be transformed into zeolitic material using low cost methodology. High percentage of fly ash is converted into zeolite due to alkaline hydrothermal treatment. The formed zeolite is not needed to be separated from unreacted fly ash. The whole material as such can be used as zeosynthetic liner (permeable reactive barrier) for ground water remediation. In laboratory experiment fly ash zeolite liner has been found very effective in removing many pollutants including heavy metals from pond ash leachate water. A field investigation is needed to be carried out for confirmation of utilization of fly ash zeolite liner for disposal of fly ash into abandoned opencast mine.

Field : Environment & Ecology — Project Code : EE/37

1.	**Name of the Project**	:	**Survey and ecological conservation of NLC environment through bio-remediation with tree species.**
2.	Implementing Agency	:	Neyveli Lignite Corporation, Neyvelli
3.	Sub-implementing Agency	:	Tamil Nadu Agricultural University, Coimbatore
4.	Project Leader/ Co-Ordinator	:	Shri K.C. Radhakrishnan / Dr.S. Santhanam, NLC Prof. (Dr.) G Pathmanabhan , TNAU
5.	Date of Start	:	May 2007
6.	Date of Completion	:	Apr 2010
7.	Total Approved Cost	:	Rs.77.87166 Lakh For NLC : Rs. 25.30 Lakh For TNAU: Rs. 52.57166 Lakh

DESCRIPTION OF THE PROJECT

8. Objectives :

(a) To survey the ecological diversity of NLC as influenced by air born contaminants viz CO_2, SO_2 NO_x

- (a) Survey of the vegetation pattern of NLC
- (b) Identification of bio-indicators.
- (c) CO_2 distribution through infra red imagery.

(b) To study the Photo-remidiation efficiency of the existing green belt of NLC to air born contaminants viz CO_2, NO_2 and SO_2 and soil born contaninants.

- (i) Absorption efficiency of vegetation for in pollutants.
- (ii) Apsorption efficiency for CO_2 by afforested tree species, flora and fauna..

(c) To evaluate tree species and fruit saplings to tolerance to air and soil born contaminants for sustaining for clean environment in and around NLC.

(d) To study short-term and long-term effects of air and soil born pollutants on tree species and fruit crops.

9. Work Done :

The tree species, fruit trees and other shrubs existing in NLC around 8 km. radius along windward sides of origin of pollutants are recorded and documented for the following parameters like weather parameters, soil characteristics, morphological traits, physiological characteristics, Biochemical constituents etc.

Assessment of phyto-remediation efficiency of existing tree species and fruit trees to the prevailing pollution load at NLC.

The CO_2 distribution pattern are assessed through IR imagery. Seasonal variation in CO_2 distribution studies by suitable air pollution sampling protocols,. The permanent bio indicators are identified and their absorption pattern are monitored.

10. Findings

Thirty three locations for regular sampling of soil, water and plant samples were identified by an elaborate survey of the NLC area covering 8 kilometers radius. Soil microbial population was not altered much during the study period except pre monsoon and winter which recorded decreased level of microbial population irrespective of location and wind direction. The water sample analysis values are very low and there is no pollution effect on water sources attributable to pollution from power plants. The variations in values at different locations are more due to the mineralogical conditions of soil strata.

Carbon dioxide was measured at 33 locations and seasonal variations of CO_2, were studied. It is seen that CO_2, values were high during the winter months possibly due to low temperatures, high humidity, low PAR and reduced photosynthetic activity. The CO_2, values were low during June to September when the climate was rather hot. Though there was marginal increase in CO_2, values at certain locations probably due to wind direction and proximity to power plants, overall the trend was the same. The photosynthetic activity by trees results in reduction of ambient CO_2, levels as seen from the lower values in summer and monsoon seasons. Continuous ambient air monitoring was also carried out for assessing the prevailing levels of sulphur dioxide, Oxides of nitrogen and Suspended Particulate Matter at thirteen locations in and around Neyveli.te. The results show that all the values are well within the prescribed limits. The wide spatial distribution of power plants and the higher stack heights promotes dispersion of all gaseous pollutants.

The predominant tree species existing in all the 33 locations were identified and 4 species were selected for regular sampling and analysis. A total of 51 sampling was done during the period of study. The samples were subjected to routine morphological, physiological, biochemical characteristics analyses by adopting standard protocols. A total of 51 tree species were sampled in 33 locations of NLC. The Air Pollution Tolerance> The phytoremediation studies using OTC were carried out at TNAU under simulated conditions to assess the performance of the tree saplings to CO_2, NO_2 and SO_2. A total of 42 tree species were evaluated for elevated level of CO_2, (750 ppm) for phytoremediation efficiency out of which 22 of them were found to have high CO_2, assimilation rate.

For assessing the phytoremediation efficiency of tree species to SO_2 pollution 55 tree species were evaluated and 16 of them were found to posses phytoremediation efficiency by high sulphate content in the plant tissues by accumulating more sulphate. A total of 44 tree species were evaluated for phytoremediation efficiency of NO_2 pollutant and 16 tree species were identified as tolerant and posses phytoremediation efficiency.

Vegetation mapping of NLC flora covering an area of 380 km was done through IR imagery in collaboration with M/s. Salim Ali Centre for Ornithology & Natural History (MoEF) SACON, Hyderabad.

Mass multiplication of elite tolerant tree species through tissue culture technique was attempted in neem and eucalyptus. The protocol for mass multiplication was standardized and presented.

Field : Environment & Ecology — Project Code : EE/38

1.	Name of the Project	:	**Low cost input technology for re-vegetaion of coal mine spoils in order to protect the environment.**
2.	Implementing Agency	:	TM Bhagalpur University, MCL & NCL
3.	Project Leader/Co-Ordinator	:	Prof (Dr.) A.K. Roy
4.	Date of start	:	May 2007
5.	Date of Completion	:	Mar 2010
6.	Total Approved Cost	:	Rs. 26.263 Lakh

DESCRIPTION OF THE PROJECT

7. Objectives

a. Eco-diversity of micro flora on different aged OB dumps (ECL, BCCL, NCL and CCL) in relation to developing native or artificially raised vegetation.

b. To screen out common efficient microflora used as bio-tools for the establishment of plant species on OB dump.

Development of eco-friendly microbial package for the restoration of vegetation on OB dumps or mine spoils at regional & national level to sustain the effect of variable biotic & abiotic factors

8. Work Done

(i) Identification and documentation of native flora

(ii) Collection of rhizosphere & non-rhizosphere soil of native plants

(iii) Study of chemical soil profile

(iv) Screening of common indigenous micro flora including VAM fungi

(v) Development of bio-inoculants package

(vi) Selection of plants for revegetation

(vii) Polybag experiment under green house condition

(viii) Establishment of microbial consortium

9. Findings

The successive improvement in different physico-chemical and biological parameters of mine refuse through the plantation of different leguminous and non-leguminous plant species together with suitable amendments.

(i) Among the different biological parameters, VAM and N2 fixing bacterial activity of the mine refuse was found to increase at successive stages, thereby suggesting improvement in the biological activity and the fertility status of the mine refuse.

(ii) Out of nine different treatments (T1-T9) adopted during the present investigation T6 (Vermicompost+Mycorrhiza+N2FB) was found most suitable bio-inoculants package for improving the rate of survivality and growth performance of plant species. The OBD soil samples were amended with nine different treatments (T1-T9).

(iii) An increase (17-22%) in finer fraction among the textural composition after 12 months of the plantation has been observed,which clearly suggest that the planted vegetation on the OBD is quite responsible for weathering of the gravely matter to a great extent.

(iv) The bulk density of the mine refuse (OBD) gets considerably decreased after plantation. An appreciable increase in water holding capacity and porosity was subsequently noticed which in turn, improves soil characteristics favouring growth performance of the plant species.

(v) The pH of the mine refuse shifted from alkaline to slightly acidic after 12 months of the plantation, thereby creating congenial conditions for the plant growth with good morphology.

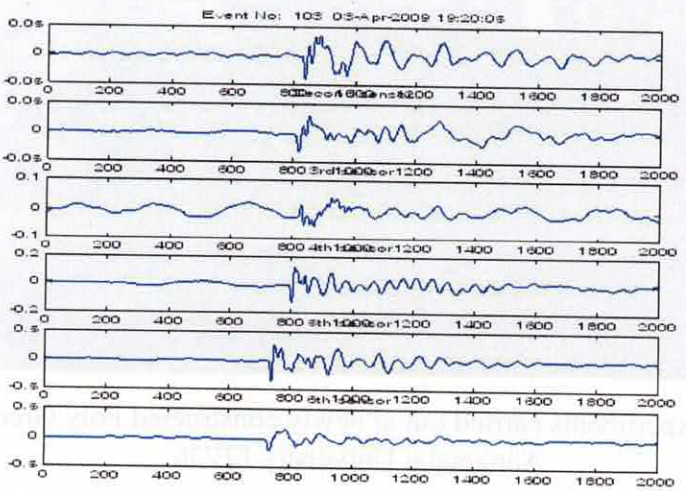
All the planted species viz. Bauhinia purpurea, Cassia siamea, Cymbopogon citratus, Dalbergia sissoo, Dendrocalamus strictus, Delonix regia, Gliricidia sepium, Jatropha curcas, Pongamia pinnata, Pterocarpus santalinus, Sesbania grandiflora, Stylo hamata, Terminalia arjuna, Terminalia chebula, and Terminalia bellirica showed an appreciable increase in plant height, no. of leaves & no. of branches.. The overall growth condition of the planted species on the experimental site was luxuriant and their survival rate was as high as 72-93%.

Among the plant species studied, leguminous plants attained maximum plant height, number of branches and number of leaves. It is observed that the plant species having better canopy coverage enhance photosynthetic activity and sequestration of CO_2. This leads to a significant reduction in the major Green House Gases (CO_2) in the mining area resulting protection of the environment to great extent.

The vegetation through canopy cover, ground cover by litter, herbage cover and binding by fine root ramification is found to reduce erosive power of the rain and run off water. It is evinced that Cymbopogon citratus among the herbaceous vegetation and Gliricidia sepium, Dalbergia sissoo, Sesbania grandiflora and Dendrocalamus strictus among the hardy species showed considerable water and soil conservation potentials. The plant species growing on sloppy land of the OB dump respond differently to rainfall volume, rain intensity and antecedent soil moisture content.

Micro-sesimic data acquisition system – MT/145

Geophone sensors installed over he study area – MT/145



Poly green house pot culture experiment with bhendi – EE/36

Pot culture experiments carried out at newly constructed Poly Green house at Annamalai University EE/36

Measurement CO2 absorption, conductance, transpiration rat, PAR etc with LICOR Analyzer at NLC Neyveli – EE/37

LICOR, PHOTOSYNTHESIS ANALYZER – EE/37

Delonix alata

Bauhinia vareigata

Alstonia scholaris

Citrus limon

Ficus religiosa

Lagerstroemia speciosa

Selected tolerant tree species suitable for planting in and around NLC, Neyveli – EER/37