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अमृत महोत्सव



# *Glimpses of* SOME COMPLETED RESEARCH & DEVELOPMENT PROJECTS IN COAL & LIGNITE SECTOR

*Funded by:*

**Ministry of Coal & Coal India Ltd.**



**NODAL AGENCY**

**Central Mine Planning & Design Institute Ltd.**

*(A Subsidiary of Coal India Limited)*

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## 1. Self - Advancing (Mobile) Goaf Edge Supports (SAGES)

A medium duty 2x200t capacity Self-Advancing Goaf Edge support (SAGES) for underground coal mines has been developed. Successfully undergone field trials at one of the U/G mines of BCCL and at RK-7 U/G mine in Srirampur area of SCCL.



### Salient Features of SAGES

- Medium duty 2x200t capacity.
- Crawler driven under carriage with an integral Power Pack and Electrical control box.
- Base with Double Telescopic Legs.
- Canopy with Stabilizers.
- Light weight, economical and easy to transport to sites below ground.
- Self-contained power pack
- Remote radio-controlled through a radio-receiver located inside a Flame Proof (FLP) control box.
- Digital Display system with 24x7 Pressure & Displacement Logging and real-time monitoring

### Specification of SAGES

- |                               |                          |
|-------------------------------|--------------------------|
| • Support Capacity            | : 2 x 200 t              |
| • Hydraulic Legs              | : 2 nos, 200 mm dia bore |
| • Setting load of the support | : 100 t                  |
| • Support Closed height       | : 1850 mm                |
| • Support extended Height     | : 3200mm                 |
| • Overall length x Width      | : 2500 x 1500 mm         |
| • Canopy Length x width       | : 2000 x 1400 mm         |
| • Weight                      | : 9 t                    |

**Support Mode:** Base gets lowered, rests on the floor, Canopy raises and touches the roof. Load of the roof strata, coming on the Canopy, gets transferred to the floor through two legs and the Base. There will be no load on the Crawlers.

**Mobile Mode :** The base gets lifted up and the support weight is transferred on to the crawlers through the Links.

The Design features makes the support lighter in weight (only 9t) with reduced cost as compared to commonly used mobile supports available for the purpose.

### Benefits of deployment of SAGES for Extraction of coal pillars

- Withdrawal and setting of the SAGES are done from a remote place up to 50m from the Goaf edge i.e. active mining area.
- Overall cost of a Breaker Line support will be less with SAGES compared to that of the existing supports
- Provide active roof support ensuring more safety. People can work more confidently under the coverage of huge support capacity of SAGES.
- Increase in percentage of coal extraction from coal pillar, facilitates regular caving of the roof strata.
- Eliminates the need for installation of separate strata monitoring and warning indicators at coal faces as they are inbuilt in SAGES.
- Eco friendly system of support eliminates use of timber chocks and prop, saving a huge quantity of trees.

**2. Development of methodology for rapid volumetric analysis of excavated in-situ overburden integrating high resolution satellite, Air Borne Laser Terrain Mapper (ALTM) and Terrestrial Laser Scanner (TLS) data supported with Electronic Total Station (ETS) through digital photogram metric technique.**

A methodology for rapid volumetric measurement has been developed using Terrestrial Laser Scanner and validate it against conventional measurement with Electronic Total Station (ETS). The project was executed at the test sites at Gevra opencast project of SECL and Belpahar opencast project of MCL. The results of measurement of OB volume by TLS was compared with the measurements by ETS, which was already accepted in Coal India Ltd. as standard practice. The variance in volume was well within the limit, therefore, subsequently, TLS has been deployed into regular services for OBR check measurement. TLS measurement reduces 75% time and 50% manpower than conventional survey.

**3. Design, Develop and Demonstrate - a micro-grid system for optimization and control of multiple source of power supply**

The solar photovoltaic plant has been commissioned on the roof tops of CMPDI office buildings. The total installed capacity of the plant is around 191 KW, which is at present generating 30% of total installed capacity. Two types of technologies, one with string inverter and another with micro inverter have been adopted in installing the plant. Under this project, conventional grid (utility supply) clubbed with solar PV system and DG sets through grid interactive inverters to feed to internal grid (CMPDI) whenever utility grid (JSEB) supply is not available. Further, CO<sub>2</sub> emissions into the atmosphere will also be reduced by generating this clean energy.

The total life of the plant is about 25 years and requires very little maintenance. Approximate generation cost of 1 unit of solar energy is about Rs. 6.0 which is much cheaper than the energy generated through Gen sets.



CMPDI roof top Solar Plant



Monitors for Solar Plant

**4. Studies of techno-commercial efficacy of ANFO with low density porous prilled Ammonium Nitrate for blasting overburden in Coal mines**

For efficiency study, 52 blasts conducted at Durgapur OCP, WCL (26 numbers of blasts with ANFO explosive and 26 with SME explosive) on same benches having same geo-mining conditions and performance of blasts were monitored for PPV, Fragmentation, VOD, Powder factor etc.

It has been found that ANFO blasting produced 42% increase in powder factor with better fragmentation compared to SME. Confined VOD & PPV was also observed minimal compared to SME. ANFO provides savings of Rs 1.78 /m<sup>3</sup> as per RC of CIL for year 2019-21 and Rs. 3.86/m<sup>3</sup> as per RC of CIL for year 2017-19.

Use of ANFO is under process in WCL & MCL for dry holes blasting.



**5. Development of guidelines to predict distance between toe of the Shovel-Dumper dump and that of Dragline dump with consideration of safety and economical design of both Shovel-Dumper dump and Dragline dump.**

Study conducted in twelve dragline operated opencast mines of CIL for development of guidelines to determine the optimum distance between toe of dragline dumps and shovel-dumper dumps.

It had been concluded that the toe of shovel-dumper dump is formed at least 110-180m away (site dependent) from the toe of the dragline dump.

**6. Seismic data processing, interpretation and identification of thin coal seams using Inverse Continuous Wavelet Transform Deconvolution (ICWT-Decon) for resource estimation**

Successfully developed a software for Spectral Enhancement (SPE) which will help in identifying thin coal seams under the earth crust and improve assessment of resources of fossil fuel using seismic survey during exploration process. It will also help in enhancing resolution of seismic signals leading to delineation of the thinnest coal seams. The developed SPE software and the new workflow has successfully reduced the drilling cost including number of core and log well data. This "Made in India" software will help in saving time and cost of exploration. The software is being used in CMPDI for resource estimation.

**7. Enhancing life of de-watering pipes in coal/lignite mines by prevention of erosion-corrosion with nano-crystalline surface Engineering Treatments**

Six types of metallic coating and three types of non-metallic (poly-urea coating) were developed for coating on the Fe410 grade substrate for erosion and corrosion resistance. All combination of poly urea coating were found to have extremely good corrosion resistance in all environment as well as possess good erosion resistance. On comparing the cost-economic of both metallic and non-metallic coatings for mining application, it was found that the poly –urea coating were very cheap and economical and the life of the coated pipelines will be approximately 6-10 year. The poly –urea coated pipes were put in to service in different mines and periodic evaluation of these pipelines was conducted by NIT,Tiruchirappalli and NLCIL Neyveli. The coating was intact and the performance of the coating was found to be satisfactory.

- Expected life of coated pipe 10-12 years against normal life of 2 years (max.)
- Expected cost saving of Rs. 6.0 Cr/annum for 125 KM pipe line.

**8. Electronification of Ground Water Control and Conveyor System in Mines**

- Real time automation of Ground Water Control (GWC) system developed.
- Parameters like flow, level, energy of the bore well located in the mines are monitored continuously.
- Continuous monitoring of parameters like vibration, temperature, energy of the Conveyor drives in the mines through Internet of Things.
- Real time monitoring system shows the online display to the operation and maintenance crew for the routine planning and for safe operation of men and materials.
- Developed system under operation in the Mine No.-II of NLCIL.

## 9. Investigation pertaining to geotechnical & hydrogeological aspects to stabilize the non-cohesive granular soil / sand in the opencast mines adjacent to the major perennial river

- Successfully demonstrated the utility of Green Facia Reinforced Earth (GFRE) wall for stabilizing the mine sidewalls/slopes in cohesion - less soils to prevent extremely heavy inflow of water from Perennial River.
- Application of hydro-seeding in creating an environmentally synergetic stable sidewall has also been demonstrated.
- Such an approach would create a safe mining environment for enhanced coal recovery.
- Demonstrated at Bhanegaon OCP of WCL at a stretch of 50 m.



## 10. Sustainable livelihood activities on reclaimed open cast coal mines: a technology enabled integrated approach in Indian coal sector

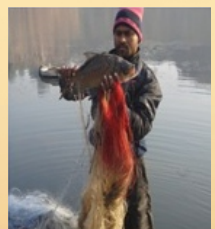
A permanent eco-friendly green cover was developed on OB dumps/ backfilled mined areas, which in turn develops entrepreneurship and vocational skills among the local community for empowerment in and around the project affected areas. Project was demonstrated at Muraidih OCP, BCCL.



## 11. Assessment of mine water environment and development of suitable and cost effective mine void aqua eco-system for promoting Fish culture in abandoned coal quarries of Coal India Limited

- Cost-effective aqua eco-system has been developed for promoting pisciculture in post-mining voids and abandoned coal quarries of CIL
- Improve the water quality through biological method for suitability of pisciculture, selection of suitable fish species and pisciculture techniques.
- Developed suitable cost effective guideline for use in coal quarries for income generation.
- Outcome of the project is being practiced at Sangam OCP, CCL.
- Pisciculture becomes a sustainable livelihood of the project affected people in & around Sangam OCP, CCL.

### Fish Growth



After 6 Months  
of Stocking

After 18 months  
of Stocking



## 12. Constructing structures on backfilled opencast coal mines: An attempt to suggest viable methodologies

- A two storey building with an extra underground storey has been constructed on the OB dump of Jagannath OCP, MCL.
- Guideline framed for construction of habitable structures on backfilled opencast mines:
  - Backfill, chosen for construction, should be more than 5 years old.
  - Considering non-homogenous and uncertain nature of the soil, the design value of the bearing capacity should not be taken more than  $5t/m^2$ .
  - The low rise structure, constructed at a distance of about 1 KM away from the blast location, may perform safely.
- The constructed building continuously monitored for 1 year 6 months and no deformation
- Found stable even after two cyclones.



## 13. Optical Fiber based solar illumination of pit bottom and underground mine roadways and working face

An optical fiber based hybrid illumination system for mines that functions during sunny / cloudy days and nights has been designed and installed in Jhanjra UG project, ECL. This completely solar power driven, optical fiber based illumination system provides  $> 50$  lux of illumination at pit-bottom.

The illumination of the underground mine has been carried out first time by two mechanisms: (i) coupling of natural sunlight into optical fibers by Fresnel lens, and (ii) coupling of solar power driven high-power continuous-wave artificial laser light into optical fibers. The coupling of lights was carried out on the surface of the underground mine (300m from surface) and the optical fibers were taken into the underground mine through the mine shaft in rugged conduit made of Permanently Lubricated (PLB) High Density Poly Ethylene (HDPE) duct pipes. On a sunny day, natural sunlight is directly focused into the optical fibers with the help of Fresnel lens and illumination can be achieved in the underground mine. The sunlight is also used to generate electrical power with the help of photovoltaic solar cells mounted on the surface of the mine. The electrical power accumulated in the batteries are used to drive two high-power lasers during cloudy days and nights.



## 14. Multiple layer trial blasting for better recovery with less diluted coal

Simultaneous blasting method of multi-layered overburden and coal strata has been developed & evaluated by field trial at two large opencast coal mines i.e. Khadia & Nigahi OCP of NCL. In this method, overburden and coal can be drilled, loaded with explosives & detonators and blasted in a single cycle. Designs in each layer generally differ in explosive type and powder factor, inter-hole and inter-row delays, direction of initiation and initiation time and position, making this method distinct from conventional blasting.

In all the blasts, the ground vibrations and air over pressure measured were well within the prescribed limit set by DGMS. The

efficiency of production operations improves due to saving in time and reduction in loss-time of the HEMMs.



### 15. Development of an on-line coal washability analyser

An X-ray based instant online coal washability analyser developed which can save time as compared to traditional float-sink tests. Installed at CSIR-CIMFR (Digwadih campus), Dhanbad.



### 16. Development of tele robotics and remote operation technology for underground coal mines

- Developed mobile robot, which is capable of operating in the underground coal mine environment through tele-operation as well as gathering valuable environmental information like  $\text{CH}_4$ ,  $\text{CO}$ ,  $\text{CO}_2$ ,  $\text{O}_2$  and their level.
- Also measures air flow rate, humidity & temperature of the environment using on board sensors.
- Real time graphical-user-interface (GUI) based navigational camera mounted on the robot is capable of displaying the status of robot in the underground mines.
- Field trial conducted at Khottadih UG mine, ECL.



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

- Nuclear technique was established with dual gamma-ray transmission for analysis of coal ash and moisture contents.
- Truck Mounted Mobile Coal Sampler with instant and cost-effective ash and moisture analyser developed for collecting coal sample up to 6 ft depth from open railway Wagon/Truck determining ash and moisture contents, GCV in 10-12 min.

### 18. Indigenous Development of Integrated Dumper Collision Avoidance system for Opencast Mines

To ensure the safety of human life and to protect loss of equipment due to collision of dumpers in opencast mines, Dumper Collision Avoidance System (DCAS) has been developed indigenously, trialled at KDH opencast mine of Central Coalfield Limited (CCL). This three layer system consists of proximity sensors mounted on dumpers on three sides to detect objects within 10m range, distance and direction information of dumper present in the vicinity of 100m and also positional information of the dumper through GPRS. This is the first time that such an integrated cost-effective dumper safety system with such features has been developed in India.



### Dumper Collision Avoidance System

## 19. Dry beneficiation of High Ash Indian Thermal coal

To explore the possibility of dry beneficiation of non-coking coals from Talcher and Ib Valley coalfields, MCL, a R & D was taken up by air-fluidization technique to produce clean coal with 34% ash for application in thermal power plants and to develop a process flow sheet for maximizing the recovery of clean coal. On the basis of the outcome of the project, Techno-Economic Feasibility Report (TEFR) was also prepared under the above project.

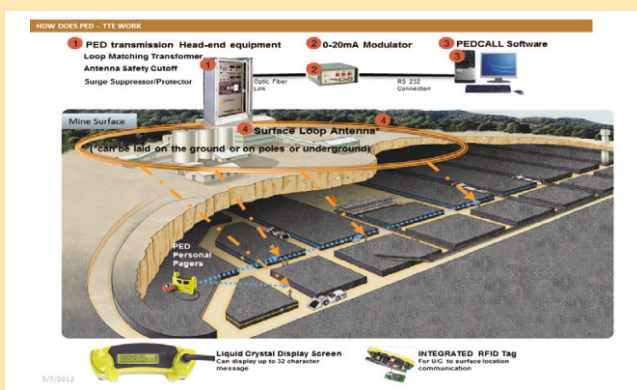
Hingula coal of Talcher Coalfields, MCL has encouraging outcomes [yield 66.4% with 33.49% ash] with a very small payback period. However, Coal from Ib Valley coalfield was found not techno-economical viable by dry beneficiation due to its characteristics.



## 20. Integrated Communication System to communicate and locate trapped Underground Miners

The Integrated Through-the-Earth (TTE) messaging and also two-way wireless voice communication system was developed and installed successfully by M/s Acept Technologies Pvt. Ltd, Kolkata & CMPDI, Ranchi at Bhurkunda Colliery of CCL, for communicating with the workers in underground and also locating (tracking) the miners in case of mine disasters.

The integrated system was successfully trialled with digital wireless telephones in Bhurkunda mine, CCL. One can make and receive a phone call from underground to anywhere.



**At present, there are 46 ongoing Research Projects.**



For any query, please contact :

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