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Persons in the News

Shri Pradip Kumar Mishra appointed as Director (Commercial) National Aluminium Company Limited. Shri Mishra has been working with Steel Authority of India as Executive Director since December 2, 2016. Prior to this he worked as General Manager in-charge of Salem Steel Plant from July 2016. Under his able leadership, the plant witnessed several improvements in production and productivity including the stabilisation of newly commissioned Steel Melting Shop and New Cold Rolling Mill complex. Shri Mishra completed his engineering course from REC, Rourkela (at present NIT) in Metallurgy. He joined SAIL's Bokaro Steel Plant in 1980 as a graduate engineer.

Kaustubh Sonalkar appointed as President–HR and Chief Executive Officer–Essar Foundation**.** He holds a bachelor's degree in Science from the University of Mumbai and has a master's degree in Personnel Management from the University of Pune (HR & Behavioural Sciences). He also has an MSc from the London School of Economics. Additionally, he is a Chartered Fellow of CIPD (United Kingdom) and Chartered Fellow of CPHR (Australia). With more than 20 years of experience, he brings to the table a rich and vast experience of having worked in multiple sectors and geographies, with renowned companies. This is his second stint with Essar. He was affiliated with Essar Energy for many years. Prior to this stint at Essar, he was associated with Future Group as the Group Chief People Officer. He was also the Senior Partner/ Executive Director at PWC.

Shri Kaustubh joins Essar at a strategic inflection point in its evolution. Having completed a Rs 1,20,000 crore capital expenditure programme and a Rs 77,000 crore deleveraging campaign (the largest by any Indian corporate) in 2017, Essar is on a sustainable growth trajectory. A company forged from a strong entrepreneurial vision, people centricity has always been at the heart of Essar's cultural ethos. It has promoted the spirit of entrepreneurship in its people, as well as in the communities that it impacts. In tandem with employee-centric policies and practices, Essar, through the Essar Foundation, has been working towards the uplift of the communities around the company's manufacturing locations across eight

Indian states. It has touched the lives of a million people across 500 villages in areas like education, health, environment, skill development and women's empowerment. Speaking on his appointment, he said, "I am delighted to be a part of Essar family again. I look forward to this new, exciting role that will require me to engage with both our people and the community at large, the pillars on which Essar stands, and take the brand to loftier heights."

Shri Susanta Kumar Roy appointed as Director (Projects) NTPC Limited. Prior to this , Shri Roy held the post of Executive Director(Projects), NTPC. Shri Roy, a Mechanical Engineering Graduate from REC, Durgapur joined NTPC in 1981 as Executive Trainee. He is having more than 36 years of experience in large size coal power Stations in the area of operation, maintenance and project construction. He was associated in managing largest station of the country at Vindhyachal. Shri Roy has worked at Korba, Unchahar, Singrauli, Rihand and Vindhyachal stations. Shri Roy's experience in power sector include 10 years of senior management level as O&M Head and Business Unit Head of NTPC's largest stations at Korba and Vindhyachal. He has also worked as Executive Director (Operation Services) at Corporate Centre . Shri Roy has a rich experience and exposure of entire life cycle from concept to commissioning of projects. Shri Roy during his stint at NTPC has been deputed for overseas managerial, leadership development and technical training programmes to enhance strategic leadership qualities.

John Davidson appointed as President, Europe & Africa of Birla Carbon. He will have full P&L responsibility for Europe & Africa and will join the company's Senior Management Team reporting to John Loudermilk, Chief Operating Officer, Birla Carbon. Shri John has a proven track record of outstanding results, market focused leadership in a variety of geographies, and brings a wealth of experience strengthening customer relationships," stated John Loudermilk. "We look forward to him joining our executive team to help drive our global strategy." Shri Davidson has over 28 years of industry experience and joins Birla Carbon from Lanxess where he led their Bromine & Derivatives business following its acquisition of US based Chemtura. Prior to Chemtura, John held a variety of leadership roles with The Dow Chemical Company including Global Commercial Director, Industrial Goods Industrial Solutions Enterprise; Global Business Director, Amines and Chelants; Global Marketing Director, Polyglycols, Surfactants, Fluids and Oxygenated Solvents; and Global Asset Director, Specialty Alkoxylation assets, Polyglycols, Surfactants and Fluids.

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Indian Mining Industry News

MINING NEWS

NALCO TO INVEST OVER ₹10,000CR IN NEXT 5 YEARS

At the 38th Foundation Day ceremony of the Navratna company, Joint Secretary of Ministry of Mines Subash Chandra said Nalco is going for huge capacity expansion and it has planned to invest more than ₹10,000 crore in next five years. Despite a sluggish global market, Nalco has been achieving continuous success, he said. Stating that aluminium wad discovered in 1820s and the precious metal was preferred by the kings and royal families worldwide at that time, Chandra said compared to any othyer metal, it has huge potential for the future. Also CMD Tapan Kumar Chand highlighted the company's significant performance in the last fiscal including the accolades achieved for being the lowest cost producer of alumina in the world and second highest net foreign exchange earner in the country. On the sidelines of signing MoU with National Skill Development Corporation, Chand assured to promote skill development including vocational skills among children, women, yough and different-abled which would enhance employability and offer them better livelihood. Awards were presented to individuals and organisations for their significant achievements in various fields. While noted music director Prafulla Kar was conferred with Lifetime Achievement Award, legendry flutist Hariprasad Chaurasia was felicitated for his significant contributions.

Nalco Kalidas Awards were presented to Prof. Atul Kumar Nanda and Prof. Sukanta Kumar Senapati for their contribution in Sanskrit literature and Nalco Kharavela Awards were presented to Nirod Kumar Dehury, Sonali Mohapatra, Manisha Manaswini and Sugyani Mahapatra for their contributions to Odissi dance. Similarly, Nalco Literary Awards were presented to Dasarath Das and Shantanu Kumar Acharya while Badri Prasad Mishra was feliciated for his contributions to environment protection. As part of the company's endeavour to encourage swachhata drive in schools, 10 schools from Angul, Damanjodi and Vizag region were awarded.

BHEL BAGS ORDER FOR SETTING UP 660 MW POWER PROJECT

Bharat Heavy Electricals Limited (BHEL) has won an order for setting up a 660 MW coal-based thermal power project with supercritical paramet ers in Maharashtra. The thermal power project is valued at over ₹2,800 crore and it will be set up as an expansion project (Unit 6) of Maharashtra State Power Generation Company's Bhusawal Thermal Power Station (TPS) in Jaigaon district, Maharashtra.

NTPC DADRI INSTALLS SOLAR POWER PLANT

NTPC Dadri, as part of its corporate social responsibility initiative, installed a roof top on-grip solar power plant at Collectorate Bhawan and Dadri Tehsil Bhawan. The power plant at Collectorate Bhawan with a capacity of 60 kilowatt was installed at an expense of ₹36.6 lakh. At Dadri Tehsil Bhawan, the plant with 35 kilowatt capacity was set up at ₹25 lakh.

ADANI POWER POSTS ₹792 CR NET IN Q3

Adani Power reported a net profit of ₹792 crore for the third quarter of FY18 compared with a net loss of ₹823 crore in the year-ago period. However, consolidated basis, the company's net loss widened to about ₹1,290 crore during October-December 2017 from a loss of ₹668 crore in the corresponding quarter in the prervious year. Total consolidated revenue dropped to ₹4,916 crore during the October-December quarter from ₹5,491 crore in the same quarter of last year, the Adani group company said in a regulatory filling. The units sold during the third quarter ongoing fiscal were lower at 12,633 million units compared to 14,897 MUs during the corresponding quarter of the previous fiscal, the company said. Average plant load factor achieved during the third quarter of FY18 was 58 per cent, lower than 69 per cent achieved in the year-ago period.

JSPL GETS ODISHA INC CSR LEADERSHIP AWARD

Naveen Jindal led JIndal Steel & Power has been conferred with Odisha Inc CSR Leadership Award for its outstanding work in implementing social development initiatives under the Corporate Social Responsibility programmes. JSPL's executive V-P & group head (CSR & Education) Prashant Kumar Hota received ther award from Journalist Vinod Dua.

Mining Events Diary

14-17 February 2018, "MINING TODAY 2018". "International Conference-cum-Exhibition on Mining Policy, Regulation & Mining Machinery". Venue: Hitex Exhibition Centre, Hyderabad. To know more, visit: www.meaiminingtoday.com OR get in touch with us at e-mail: secretariat@meaiminingtoday.com

15-16 March 2018, "Mining Investment West Africa" Accra, Ghana. Venue: La-Palm Royal Beach Hotell. for further detailed contact: Spire Events Pte Ltd. Mining Investment West Africa, Daniel Radziszewski, Speaking, registration & general queries, 24 Peck Seah Street#02-09 Nehsons Building, Singapore, Phone: +65 6717 6018, Fax: +65 6717 6015, Email: daniel.radz@spire-events.com, Web: https://www.spire-events.com/

26 - 28 March 2018 "4th Annual Mining Investment Asia". Venue: Marina Bay Sands, Singapore, Organised By: Aspire. Contact: 24 Peck Seah Street #02-09, Nehsons Building Singapore 079314 Singapore – (Singapore) Phone : 65- -67176017

4-6 April 2018, "MANGOLIA MINING 2018". International Mining & Oil Expo. Venue: BUYANT UKHAA SPORT PALACE, ULAANBAATAR, MONGOLIA. For detailed contact: +976 11344010 Email: info@mongolia-mining.org

4-6 April 2018, "Mines and Money Asia" Hong Kong, China, Venue: Hong Kong Convention and Exhibition Centre, 1 Expo Dr, Wan Chai. For further detailed Contact: Mines and Money Asia 2018, 51-65 Clarke St, Southbank, Australia, Phone: +61 3 9008 5946, Email: asia@minesandmoney.com, Web: https://asia.minesandmoney.com/contact/

10-11 April 2018 "Mining Investment Botswana" Gaborone, Botswana, Venue: Cresta Lodge. for further detailed: Spire Events Pte Ltd. 2018 Mining Investment Botswana, Daniel Radziszewski, Speaking, registration & general queries, 24 Peck Seah Street#02-09 Nehsons Building, Singapore, Phone: +65 6717 6018, Fax: +65 6717 6015, Email: daniel.radz@spire-events.com, Web: https://www.spire-events.com

16-18 April 2018 "Mining Investment Nigeria" Lagos, Nigeria. For further detailed Contact: Spire Events Pte Ltd. 2018 Mining Investment Nigeria, Daniel Radziszewski, Speaking, registration & general queries, 24 Peck Seah Street#02-09 Nehsons Building, Singapore, Phone: +65 6717 6018, Fax: +65 6717 6015, Email: daniel.radz@spire-events.com, Web: https://www.spire-events.com/

23-25 April 2018, "Coal Processing Technology Conference & Exhibition". For detailed contact : coalprotec2018@gmail.com.

02-04 May 2018, International Energy and Environment Fair Conference "ICCI 2018". Venue: Istanbul Expo Centre, Istanbul, Turkey. For detailed Contact: FERAYE GUREL, General Manager, T: +90 (212) 334 69 39, M: +90 (532) 612 77 17, E: FerayeG@Pennwell.com

19-22 June 2018 WMC - WORLD MINING CONGRESS Astana, Kazakhstan

25 - 26 July 2018, "Mining Investment in India" Sheraton New Delhi, India. For further detailed contact: Spire Events Pte Ltd, 24 Peck Seah Street #02-09, Nehsons Building, Singapore 079314, Tel: +65 6717 6016 Fax: +65 6717 6015, enquiry@spire-events.com

29-31 August 2018, "MMMM 2018". 12th International Exhibition and Conference, Venue: Pragati Maidan, New Delhi. for further detailed contact: International Trade and Exhibitions India Pvt. Ltd., (CIN no. U92490DL2004PTC124343), B1001- 1014, 10th Floor, Statesman House Building, 29, Barakhambha Road, New Delhi 110 001, INDIA, Tel: +91-11- 66295700, Fax No: +91-11-66295780, Email: ed@itei.in, Web: www.itei.in, www.ite-exhibitions.com

2-3 October 2018 Asian Retread Conference 2018. Venue: Sima Darby Convention Centre, Kuala Lumpur, Malaysia. For detailed contact : Dato' Mohamed Ishak bin Abdul Hamid, e-mail: ishak.arc2016@gmail.com, M: +60 19 350 3036

10-12 October, 2018, IIT (ISM) Dhanbad is organising an International Seminar on **"Mineral Processing Technology MPT-2018"** (details at : www.mpt2018.org) Last date for abstract submission has been extended to 31st January, 2018. For further dertails contact: Dr P.K.Jain

31st October, 1-3 November 2018, 14th International Mining & Machinery Exhibition, Eco Park, Rararhat, Kolkata, India. For further detailed contact: Confederation of Indian Industry, 98 / 1, Velachery Main Road , Guindy, Chennai-600032, Tamil Nadu India, Phone : +91-44-42444564 / 42444520, Moblie : +91-97898 08994, Fax :+91-44-42444510, Email : imme@cii.in

Report on MineTECH Safety 2017 : National Seminar on Mining Technology for Safety

The two day National Seminar was held at Hotel Courtyard by Marriott at Bilaspur during 22-23 December 2017. Organised by The IME Journal, AKS University, Satna was the Knowledge Partner of the event. It was sponsored by NMDC Ltd, Mahanadi Coalfields Ltd, Western Coalfields Ltd, and SBL Group of Companies. M/s Trencor-Mumbai the surface miner manufacturer and Deeptec-Pune (Instruments & Infra Co.) displayed their products.AKS University, Satna was the Knowldege Partner.

Prof P.K.Banik, Vice Chancellor of AKS University was the Chief Guest of the Inaugural function, and Shri Kuldeep Prasad, Director(Technical)(Operatioopnsd) SECL; Sri M.D.Mishra, Actg. Director of Mines Safety-DGMSD(Raigarh Region), Shri B.P.Mishra, Sr. Vice President(Mines of Century Cements), Shri Anant Kumar Soni, Chairman of AKS University were the Guest of Honour. Prof G.K.Pradhan, Convenor introduced the seminar theme and welcomed the guests and delegates. Shri Kuldeep Prasad, presented the Key Note address and laid emphasis on the role of Technology for ensuring safe mining conditions in Mining in general and in the coal mines of SECL. Shri Anant Soni, stated the initiatives taken at AKS University in providing a very effective teaching environment in the University by having some of the best faculty members, laboratory facility, promoting regular visit of the students to various mines and industries, research work taken up for Mines and Industries etc. He mentioned about the visit of Mining Engineering students to Malaysia and also about 50 students attending this Seminar as delegate. Shri B.P.Mishra laid thrust on Zero Harm and Accident in any operation for achieving sustainable development. Sri M.D.Mishra, in his address representing DGMS mentioned about the initiatives of DGMS through various technical input and changes in the Regulations to achieve accident free mining operations. He also stated about how the local talent available in a mine helps in reducing difficulties in mining operations and cited the example of UG coal mines of Hindalco Industries in Raigarh region. The two issues of the Journal were released by the dignitaries in the inaugural session containg the technical papers and messages of the seminar.

Annual Awards : Prof H.R.Anireddy Memorial award for 2016 & 2017, was presented to Dr G.R.Manekar, Sr. DGM of MOIL for his outstanding contributions in the field of Hard Rock Mining and Sri Suryanshu Chaudhury of Ambuja Cements for his contributions in the field of surface mining. Prof R.K.Bopche, Professor of Civil Engineering of KIT, Ramtek was presented the DR P.N.Bose Award for his long outstanding contributions in geological sciences.

Innovation Awards were received by Sri R.K.Singh, VP(Coal Mines) of Hindalco Industries for the team effort to produce coal from underground operations with highest OMS, safety standards in addition to technology integration for overall productivity. Sri Pankaj Satija, GM(OMQ), Tata Steel, Noamundi operations was presented for opencast operations where he and his team had introduced new technology for achieveing higher productivity, utilization, and recovery of non-coal ores in addition to giving due importance to CSR, tribal development, improving medical facilities in and around Tata Steel mines, encouraging all sections of society for ecological protection, water conservation etc. In his absence the award was received by his colleagues.

The Life Time Achievement Award in recognition of the contributions made by individuals in the areas of mining, mining research, mining administration was also presented by the Chief Guest. Dr V.K.Singh, senior scientists and Head of Slope Stability at CSIR-CIMFR Dhanbad received the award in recognition of his valuable contributions to slope stability research in India. In absentia Life Time Achievement Awards were handed over to Sri M.D.Mishra for Dr Ashim Kumar Sinha (Dy.DGMS, Ranchi) & Shri V.Laxminarayanan (Dy.DGMS-Nagpur); to Sri Kuldeep Prasad(for Shri B.R.Reddy, CMD SECL), Shri Sanjay Kumar of CCL{for Sri Awadh Kishore Mishra, D(T)(P&P) of CCL}, Shri R. P. Ghattuwar (for Dr O.N.Tewari ED(MCP) of HCL-Malanjkhand),

Special Session on Slope Stability : A special session was held to deliberate on various aspects of slope design, slope monitoring & instrumentation, case studies on slope failures, slope protection measures and related issues. The session was conducted by Dr V.K.Singh who made a detailed presentation and involved the delegates in the discussions. This session had the presence of senior officials from MOIL, WCL, CCL, SECL and Sri M.D.Mishra from DGMS.

Four technical sessions were held and the deliberations were quite rich and unanimous outcome has been to integrate various technological options to make the mines safer and sustainable. A special session for the students of AKS University was also held, where students interacted with industry experts and operating managers. A total of 150 delegates drawn from CCL, SECL, WCL, MCL, SCCL, HCL, Hindalco Industries(Coal and Non-coal mines), BALCO, Adani Coal Mines(CG), Essel Mining(BCML operations), Emami Cements, Reliance Cement, JSPL, OCL-Dalmia Cements, IDL Industries, CSIR-CIMFR, NIT-Raipur, Rugta Mines, Karcher, Solar Industries(explosives), AKS University, attended the two days seminar.

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KEY NOTE ADDRESS

Underground Coal Mining in India with Special Reference to SECL

Shri Kuldip Prasad*

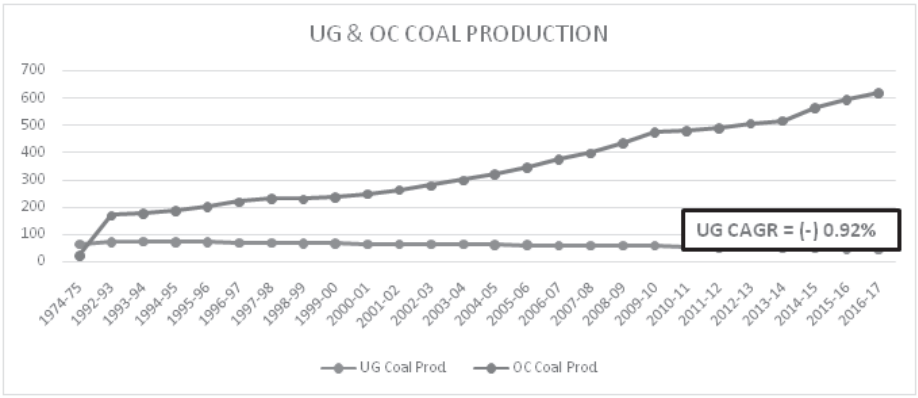
INTRODUCTION

INDIA'S ENERGY SECURITY SCENARIO & COAL SECTOR

As a prospering economy, India faces energy security as one of the biggest growing challenge as of now. India, home to 18% of the world population, uses only 6% of the world primary energy. India's energy consumption is increasing at a very fast pace and the potential for its further rapid growth in future is enormous as nearly 25% of our population today is still without access to electricity & 40% without access to clean cooking fuel. As per the NITI Aayog's India Energy Security Scenarios (IESS), 2047, the energy demand of India is likely to go up by 2.7 to 3.2 times between 2012 and 2040 with the electricity component itself rising 4.5 folds. Thus, Coal with over 55% share in primary energy supply and over 70% share in electricity generation, is playing & will continue to play critical role in supporting India's Energy plans as its share in India's primary commercial primary energy supply is expected to remain high at 48-54% in 2040. At present India's coal dependence is borne out from the fact that around 60% of the total installed electricity generation capacity is coal based. Furthermore, over 70 % of the electricity generated is from coal based power plants. The country presently has nearly 205 Giga Watts (GW) of coal fired electricity generation capacity, which is expected to grow to 330-441 GW by 2040. This is likely to translate into coal demand of 1.1-1.4 Billion Tonnes. Hence, Coal will continue to be the most important fuel in country's energy mix, even after India's recent climate pledge at 21st Conference of the Paris (COP21), underlining the country's commitment of increasing the share of low carbon sources of energy, led by solar & wind power. Accordingly, the coal production in India has to be enhanced at a greater pace to meet the country's demand. Government of India has set an all time high coal production target of 1.2 Billion Tonnes by 2020 to ensure that electricity reaches to every household by 2022. To increase coal production of India from 662.792 MT in 2016-17 to 1200 MT in 19-20, coal production has to grow at compound annual growth rate of around 22%.

UNDERGROUND MINING IN INDIA

Though, the total coal production in India has increased manifold from a modest coal production of 87 MT in 1974-75 (just after nationalization) to 662.792 MT in 2016-17; the contribution of UG mines in total production has declined from around 75% (1974-75) to a mere 6.69% in 2016-17. Thus, Post nationalization (1974-75 to 2016-17), though coal production in India has increased at a Compound Annual Growth Rate (CAGR) of around 4.95%, UG coal has declined with CAGR of (-) 0.92% during this period. The coal production from OC mines has increased at Compound Annual Growth Rate of 8.3%. The reduction in underground coal production is in spite of use of large scale mechanization like introduction of SDLs/LHDs, high capacity LHDs along with number of high production coal faces by Continuous miner over the use of early system of pick mining, use of Coal cutting machines and system of conventional drilling and blasting. This requires introspection by the mining communities as well as coal companies.



*Director Technical (Operations), South Eastern Coalfields Ltd

Corresponding Author: Shri Kuldip Prasad

To achieve the required growth rate of around 22% in coal production to meet the country's demand, production both from OC as well as UG Mines have to be increased drastically. The share of UG mines in India is far below the global average. UG mines contribute 20 per cent of production (over 400 mt) in Australia, nearly 40 per cent in the US (over 1,000 mt) and 86 per cent in China (over 3,500 mt). Considering Indian conditions, underground mines should contribute at least 25 per cent of coal production.

For a country that has 10 times higher population-density than the US and 2.5 times of China, we have already stretched ourselves a bit too far, for around 618.5 million tonnes open cast production in 2016-17. Going further is difficult, with or without privatization as:

- Opencast mining is becoming increasingly unpopular with NGOs/ Environment lobby, owing to its high environmental footprints. Compared with underground mining, the environmental impact of opencast mining is high due to large mining footprint associated with bulk mining.
- There have been instances of banning of opencast mining by several countries for environmental reasons. For instance, the south Cotabato province of the Philippines has banned opencast mining in 2010. Such impositions may further increase in the future.
- More constraints in opencast mining are now being experienced in terms of getting Forest & Environmental clearances.
- Land acquisition and R&R issue are proving to be one of the major hurdles in starting O/C coal mining projects and expansion of the existing ones. Majority of coal projects have been halted & delayed due to issues concerning land acquisition and R&R.
- More than 55% of coal reserve in India is amenable to U/G Method. Hence, we are left with less than 45% of coal reserves which can be extracted by opencast method.

The prospects of underground mining are good in Chhattisgarh, Jharkhand and Madhya Pradesh where the reserves are mostly under forest cover. These resources can be extracted without disturbing the flora and fauna too much. Instead, what we are doing is uprooting our forests, adding to the social conflict by acquiring huge tracts of land every year for stripping resources located up to 300 metres from the surface.

UNDERGROUND MINING AND SECL

SECL, right from its inception has always remain pioneer in underground coal mining and has been the largest underground coal producing company in CIL as well as in India. SECL which contribute around 21% of total coal production in India has the percentage share of around 33% of total UG coal production in India & over 46% of total UG coal production of CIL in 2016-17.

Year	Underground Production			Opencast Production			Total				
	INDIA	CIL	SECL	INDIA	CIL	SECL	INDIA	CIL	%	SECL	%
1986-87		60.07	14.90		84.7	21.25	165.77	144.77	87.332	36.15	21.81
1996-97	70.952	55.191	15.805	218.369	195.432	39.499	289.321	250.62	86.625	55.304	19.12
2006-07	57.698	43.326	16.2	373.134	317.609	72.3	430.832	360.94	83.776	88.5	20.54
2016-17	44.347	31.477	14.547	618.455	527.987	125.456	662.802	559.46	84.409	140.003	21.12

But, even in SECL the share of underground coal production in SECL has declined sharply from 41.21% in 1986-87 to mere 10.39% in 2016-17, which is a matter of grave concern. (Fig. in MT)

Sl.no	Under Ground		Open Cast		Total
	Qty.	%	Qty.	%	
1986-87	14.90	41.21	21.25	58.79	36.15
1996-97	15.81	28.58	39.50	71.42	55.30
2006-07	16.20	18.30	72.30	81.70	88.50
2016-17	14.55	10.39	125.45	89.61	140.00

Due to adoption of mechanization in UG mines, the underground productivity of SECL is also the highest in CIL, although there is a lot of scope for its further improvement. The coal production & productivity of SECL from 2011-12 to 2016-17 is given as under:

Year	Production (Million Tones)			Productivity (Output/man shift)		
	OC	UG	Total	OC	UG	Overall
2011-12	97.429	16.408	113.837	19.32	1.30	6.44
2012-13	101.35	16.869	118.219	19.26	1.37	6.72
2013-14	107.845	16.416	124.261	21.45	1.35	7.23
2014-15	112.239	16.036	128.275	23.60	1.39	7.86
2015-16	122.427	15.507	137.934	23.45	1.40	8.46
2016-17	125.455	14.548	140.003	26.63	1.41	9.29

CHALLENGES OF UG MINING

- Project Viability
- Production Capacity & Productivity
- Profitability
- Safety & UG Environment
- Recovery of Coal

OPTIONS/SOLUTIONS

- Higher capacity Mega UG Mines
- Mass Production Technology
- Man Riding System
- Benchmarking of Operations & Equipment Productivity
- Mine Automation
- Technological Development & R&D

HIGH CAPACITY MEGA UG MINES

Capacity expansion of existing coal mining projects: There are u/g mines which are performing well & which have the capability to produce more. Such mines should be identified and capacity ramped up through progressive modernization. In SECL, a number of UG mines are earmarked for capacity enhancement in the coming financial years like, Khairaha UG (Sohagpur Area), Rehar-Gyatri UG (Bishrampur Area), Churcha UGRO (Baikunthpur Area), etc.

Encouraging development of new Mega U/G mines (> 2 MTY) with higher capacity equipment: Due to the geo-physical nature of India's reserves, the underground mine capacity in India is yet to touch the 2 MTY capacity mark. For example the largest UG mine in SECL is the Churcha RO UG mine of Baikunthpur Area having normative capacity of 1.35 MTY, Behraband UG (.60 MTY), can be enhanced up to 2.0 MTY production capacity.

MASS PRODUCTION TECHNOLOGY

- Continuous Miners
- High Wall Mining
- New Higher Capacity Longwall
- Continuous Miners

To augment coal production from UG mines, technology has to be upgraded. One of the proven ways that can boost underground mining is through deployment of continuous miner in more mines. It requires less investment and can work in difficult conditions, even in the absence of a long stretch of continuous deposition. The other advantages of this technology are that it drastically reduces manpower requirement & improves productivity, which is a major concern for Indian u/g mining. Continuous miners have already been deployed at many mines and it has shown great potential. SECL has already deployed 09 sets of Continuous Miners (CM) at 8 UG Mines, namely Kurja, Kapildhara, Vindhya, Churcha, Vijay West, Haldibari & Khairaha Mines including a low capacity CM at Rani Atari Mine. The total coal production from CM in the year 2016-17 is 32.417 LT, registering a growth of 77.3% over 2015-16. The company has also taken steps for introduction of continuous miners at other underground mines, namely Ketki, Rehar, Gayatri, Shivani, Pandavpara, Bangwar & Vindhya UG Mines.

HIGH WALL MINING

Similarly, Highwall Technology has been successfully commissioned in April, 2011 at Sharda mine of Sohagpur Area of SECL, for the first time in Coal India Limited. During 2016-17, 5.20 LT of coal has been produced from Sharda mine through this technology. Another new project, namely Batura Highwall is also under implementation. This technology is very useful for the mines where quarry has reached its limit and also where surface features do not permit opencast mining. This system of mining is also suitable for extraction of thin seams.

LONGWALL TECHNOLOGY

This Longwall mining technique hasn't been successful in India because, we don't have large areas of continuous coal deposits in underground. This makes estimation and implementation of mining very difficult. However, in SECL, we have successfully worked with 03 Long wall faces at Kumda, Balrampur and Rajendra UG mine. We have also successfully worked with Short-wall mining system at Balrampur-Kumda UG.

MAN RIDING SYSTEM

In the several mines of SECL, where long and arduous travel is involved, Man Riding System has been introduced. Eleven Man Riding system is operating at 10 mines namely, Churcha, Singhali, Bagdeva, Behrabandh, Pinoura, Kurja, Kapildhara, Bangwar, Shivani & Navapara (2 MR System at Navapara) mines of SECL. Commissioning of another 04 Man Riding System at Rajendra (01), Jhiria (01) & Churcha (02) mines is under process & 10 nos. MRS in 08 mines under variour stages of implementation at Jhilimili (1) Katkona-1&2 (2), Khairaha(2), Dhelwadih (1), Bijuri(1), Haldibari(1), Damini(1) & Gayatri(1)).

BENCHMARKING OF OPERATIONS & EQUIPMENT PRODUCTIVITY

Earlier benchmarking of both UG & OC equipment have been recommended by working group of Coal and lignite committee of Ministry of Coal.

Sl.	Type of Machine/Mining System	Machine Productivity Benchmark	
		tpd/Mc	OMS
SDL (Side Discharge Loader) / LHD (Load Haul Dumper)			
1.	SDL (Bucket Capacity 1 m3)	120	1.30
2.	LHD (Bucket Capacity 1.5 m3)	150	1.50
3.	SDL (Bucket Capacity 1 m3) + UDM	135	1.60
4.	LHD (Bucket Capacity 1.5 m3) + UDM	170	2.00
PSLW (Power Support Longwall)			
5.	PSLW System with 2 RHs	4800	5.00
CM (Continuous Miner)			
6.	CM(JOY 12 CM 15 or Equiv.)	1650	5.00
7.	CM in Longwall Development	825	5.00
BG (Blasting Gallery) Method			
8.	BG with 5 LHDs (Bucket Capacity 2.7 m3)	825	4.00

Such benchmarking should be done for all operations & equipment and it should be reviewed Periodically.

SAFETY & RESCUE

Mining has the distinction of being the most dangerous profession in India. Official estimates show that the average fatality rate and the number of serious accidents have been coming down (see chart), but considering the fact that for extracting 100 million tonnes of coal, seven lives were lost on an average in 2015, a lots more is required to be done in the field of ensuring safety & health of workmen.

Comparative accidents statistics of CIL

5-yearly average since 1975 vis-a-vis 2015

Time Period	Average fatal accident		Average serious accidents		Average fatality rate		Avg serious injury rate	
	Accidents	Fatalities	Accidents	Injuries	Per MT	Per 3 lakh man shifts	Per MT	Per 3 lakh man shifts
1975-79	157	196	1,224	1278	2.18	0.44	14.24	2.89
1980-84	122	143	1,018	1065	1.29	0.3	9.75	2.26
1985-89	133	150	550	571	0.98	0.3	3.7	1.15
1990-94	120	145	525	558	0.69	0.3	2.7	1.19
1995-99	98	124	481	513	0.5	0.29	2.06	1.14
2000-04	68	82	499	526	0.28	0.22	1.8	1.47
2005-09	60	80	328	339	0.22	0.25	0.92	1.04
2010-14	56	62	219	228	0.14	0.23	0.49	0.8
2015	37	37	135	141	0.07	0.15	0.27	0.56

The Constitution of India also has specific provisions for ensuring OSH for workers in the form the three Articles 24, 39 (e and f) and 42. One of the reasons why the Coal Mines (Nationalization) Act was enacted in 1973, taking over private sector mines, was their poor safety records. Yet, work at public sector mines remains a highly dangerous. SECL firmly believes that good safety performance is an integral part of efficient & profitable business management & is fully committed to total safety in all aspects of its operations. The major safety majors being taken by SECL are:

Implementation of Safety Management Plan (SMP): Safety Management Plan have been framed & implemented in all mines of SECL. Regular monitoring, review & updating of SMPs are being done.

Commissioning of Gas Chromatograph: 03 Nos. of Gas Chromatographs (one each in Hasdeo, Sohagpur & Korba Area) have been commissioned for gas analysis. Supply order of 06 more Gas Chromatographs to be installed in Johilla, J&K, Chirimiri, Baikunthpur, Bishrampur and Bhatgaon have already been issued.

Environmental Tele-Monitoring System (ETMS): This system which monitor underground mine environment (gas analysis) have already been installed in 05 mines of SECL namely, Bagdeva, Churcha RO, Pali, Behrabandh, NCPH (New). Installation of 08 more ETMS in Bartunga, Kurasia, Malga, Rajnagar, Kapildhara, Surakachar, Rajgamar & Balgi mines is under process.

Strata Monitoring: Final extraction in underground coal mining is associated with hazards and risks of accidents relating to fall of roof and sides due to in equal strata movement in active mining zone. Strata control instrumentation and monitoring with proper analysis is being undertaken at UG Mines of SECL. Strata control instruments being installed in the panel, include TCI (Telescopic convergence indicator), Load Cell and Stress Cells, Tell-Tale, Bore-hole Extensometers, etc. The processed data from the data bank are subjected to regular analysis. The objectives of such analysis are to:

- Identify vulnerable zones/places of load concentration.
- Trend of loading characteristics.
- Evaluation of support efficacy.
- Apprehension of dynamic/periodic load in the workings and subsequent preventive measures.

Based on the above analysis needful action is taken as per the requirement.

SOPs: Standard Operating Procedures of all the critical operations in all the mines of SECL have been framed, implemented & being monitored regularly.

Future UG Production in SECL & Strategy: As per the 1 BT target of CIL, SECL has been given the target of 20.55 MT in 2019-20. This requires to increase UG coal production of SECL at Compound Annual Growth Rate (CAGR) of 12.21%.

SECL is all set to have sustainable development in its coal production by having lot of emphasis of UG coal Mining through amalgamation of small units, closure of unsafe and unviable geologically difficult ones, investing on new projects and conversion to CM and other 'Mass Production Technology.

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Eliminating the Risk in Evacuation of Coal in UG Mine – A Case Study of SMP

M.D.Mishra* R.K.Singh* Vivek Mishra** R.K.Singh***

INTRODUCTION

Despite development in technology, the unpredictability of nature in the process of extraction of minerals still makes mining one of the most hazardous peacetime occupations. It is a paradox that and in one hand exploitation of mineral is essential for sustaining economical growth and development yet on the other hand it is fraught with such risk and hazards, leaving the work persons at the mercy of unpredictable forces of nature which may not be accurately predicted or effectively grappled with.

Scope of Work

OUR CONSTITUTIONAL OBLIGATION

- **ARTICLE 39 : THE STATE SHALL, IN PARTICULAR, DIRECT ITS POLICY TOWARDS SECURING - THAT THE HEALTH AND STRENGTH OF WORKERS, MEN AND WOMEN, AND THE TENDER AGE OF CHILDREN ARE NOT ABUSED AND THAT CITIZENS ARE NOT FORCED BY ECONOMIC NECESSITY TO ENTER AVOCATIONS UNSUITED TO THEIR AGE OR STRENGTH**

- **ARTICLE 42: THE STATE SHALL MAKE PROVISION FOR SECURING JUST AND HUMANE CONDITIONS OF WORK**

Thus comes our Social Goal : The workman shall live to enjoy the fruits of his labour. That her mother shall have the comfort of his arms in her age. That the crippled and injured, who were once the strongmen shall not be the bye-product of the industry.

VISION OF DGMS: To attain risk and hazard free conditions of work and welfare of persons employed in mines.

Now the development, implementation, maintenance and documentation of a safety management plan **(SMP)** in relation to mining operations is the cornerstone duty to achieving the objectives of the Mine Safety Regulations 104 of CMR 2017.

CASE STUDY OF ELIMINATING RISK IN EVACUATION OF COAL IN GARE PALMA IV/4 COAL MINE

Gare Palma IV/4 is a captive coal block was awarded to M/s Hindalco Industries Limited, vide vesting order No.104/13/2015/NA dated 23.03.2015 by the Government of India, Ministry of Coal, New Delhi, [nominated authority (constituted under Section 6 of the Coal Mines {Special Provisions} Second Ordinance, 2014)], on the basis of being the highest bidder.

The fresh lease of the said coal block was awarded by the Chhattisgarh Government to M/s Hindalco Industries Limited vide Order No. F 3-20/2015/12 Raipur, dated 24.07.2015 for mining of coal from the said mine lying within latitude $22^0$07’40"N & $22^0$10’20"N and longitude $83^0$31’16"E & $83^0$31’43"E in an area of 884.846 hectares which comprises forest land, tenancy land and government land for a period of 20 years.

After reallocation of the mine working was challenging in this mine with available resources and to get the coal at competitive price for captive plant.

The Gare Palma IV/4 has been operated partially by underground bord and pillar method and combination of opencast mining method. Coal mine islocated at 55 Km from Raigarhcity. The underground working is carried out in two seams namely seam-II and seam-III, having parting of 40 mtr. The Net Geological Reserve of Gare Palma IV/4 is about 38.8465 MT, while the net extractable reserve, as on 01.04.2015 of Gare Palma IV/4 is about 15.396 MT.

DETAILS OF COAL EVACUATION SYSTEM

In both the seams coal was being mined by development only and by blasting-off-the solid with P5 explosives and mili-second delay detonators. Wedge cut pattern of shot-holes was practiced in both seams. Blasted coal, in both seams, was loaded by LHDs on to belt conveyor system for transport to the surface bunkers. Layout of coal evacuation system has been mentioned in Fig 1& Fig 2.

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***Head, CG coal mines*
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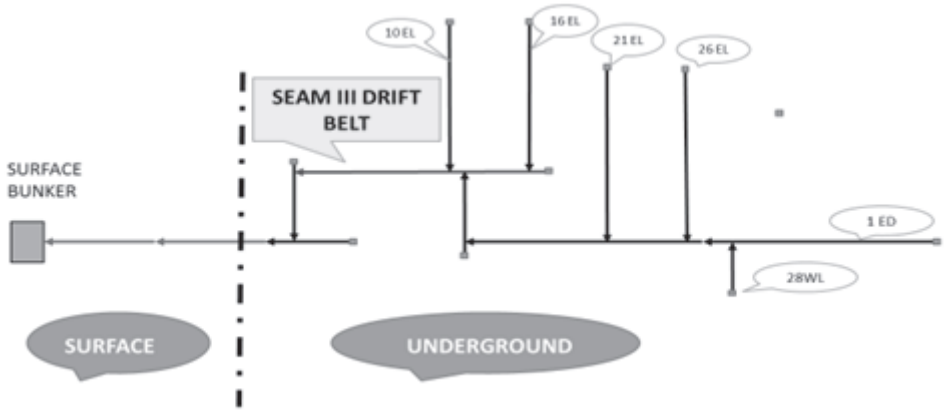

Figure 1: Single Line diagram of Belt conveyor system (Seam III)

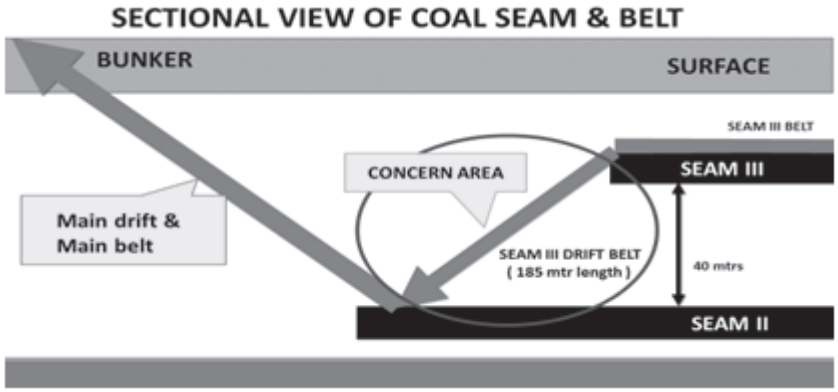

Figure 2: Sectional view of coal seam & belt

- The bottom seam is seam-II and both seams are connected to each other through in-seam drift.
- Coal evacuation from both seams is done through belt conveyor.
- Evacuation of coal from seam III to surface is being done by belt network passing through Seam III drift(Shown in Fig 2).

RISK INVOLVED IN MATERIAL EVACUATION SYSTEM

- Seam III drift belt runs in dip direction in a declination of 1:4.5. i.e. coal being transported from higher level to lower level.
- 0.6MT coal production has been planned through foresaid conveyor which is the only means of transporting or evacuation.
- Conveyor gets **over speeded** due **gravitational & momentum force** acting in the direction (Downward) of running of belt with a furious sounding.
- This was resulting to over loading/ excess discharge coal to the succeeding belt beyond its coal carrying capacity, resulting heavy spillage / accumulation of coal.
- Accumulated coal obstruct the ventilation of seam III because same drift was used as intake route for entire seam III.
- Safety concern as drift was used as travelling path for all miners.
- In case of sudden failure of power our thruster brake was unable to stop the linear movement of the belt.
- Safety features of conveyor like pull cord switches, stop switch, Thruster brake becomes ineffective.
- Supervision & Maintenance becomes difficult.

During SMP preparation of mine the risk associated to coal evacuation system the risk rating is done and it is found as below in Fig.3.

HAZ No	HAZARD	MECHANISM	CALCULATED RISK				COM MEN
			CONS.	EXPS	PROB	RISK	
1	2	3	4	5	6	7	8
BCH-1	Belt Conveyor	Lack of knowledge on Process	0.3	10	7	21	
		Deployment of unskilled person	0.3	10	10	30	
		Operation by unauthorized Operators	5	10	10	500	
		Belt Snapping	5	10	10	500	
		Drive head structure failure	5	10	10	500	
		Failure of braking system	5	10	10	500	
		Tail end structure failure	1	10	10	100	
		Failure of take up arrangement	5	10	10	500	
		Failure of conveyor drum	0.3	10	3	9	

Figure 3 : Snapshot of SMP RA sheet

PROBLEM SOLVING THROUGH BRAINSTORMING& ROOT CAUSE ANALYSIS

Brainstorming carried out for the probable reasons/causes. Also discussed the subject matter with experts from Norwest, SRK, design consultants, SECL engineers etc. The probable reasons& solution were identified as follows:

IDENTIFICATION OF CAUSES

1. Momentum and gravitational force acting on coal as well as on conveyor belt are in the direction of operation of conveyor i.e. from upper level to lower level. We have to minimize the same for successful operation.

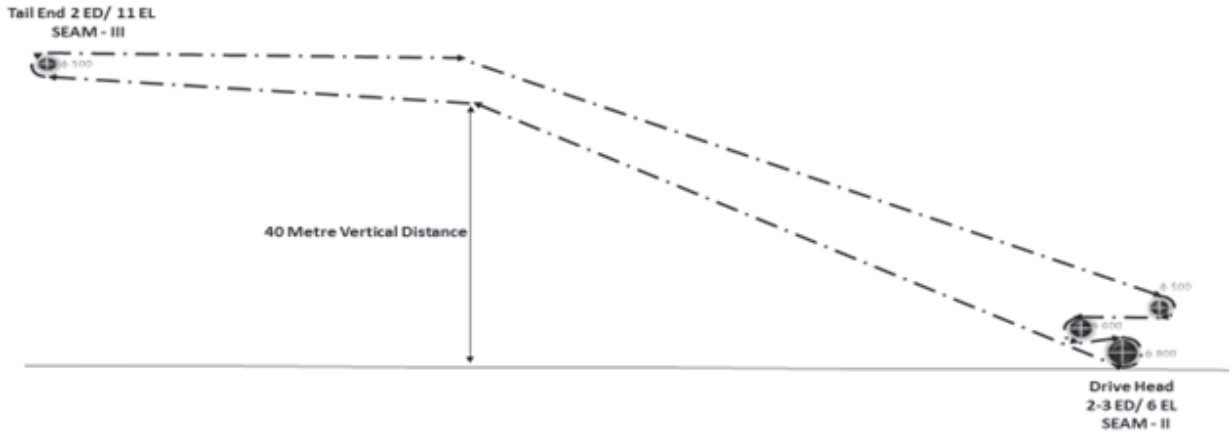

Figure 4 : Seam III drift belt arrangement having high risk factor

IDENTIFICATION OF SOLUTIONS

1. Requirement of in-seam bunker.
2. Belt extension for counter weight in rise side
3. Initial momentum can be reduced by reducing linear speed of conveyor.
4. Splitting the belt in to 3 parts and declination can be reduced.
5. Provision of "Z" loop for minimizing the declination.
6. Installation of equalizer gear.
7. Distributed loading from panel belts.

CORRECTIVE ACTION & PREVENTIVE ACTION TAKEN

1. Existing belt conveyor tail end was extended by about 150 mtr for counter weighing but result was not fruitful.
2. Linear speed of belt conveyor reduced by 25% by replacing drive drum from 800mm dia to 600 mm dia but no remarkable changes observed.
3. As per offset survey we have selected 2 point where we have maximum height of gallery
4. Idea of splitting the conveyor was good to break the momentum & gravitational force but it was very costly due to deployment of extra machineries as well as manpower for operation. So this idea was kept on hold.
5. As per fig.5 arrangement 1st "Z" loop was erected at 1st selected point 50 mtr distance from drive head by minimizing declination of conveyors i.e. declination of carrying belt (approx. 10 mtrs) reduced. As the declination reduced the momentum and gravitational force acting on coal is reduced and over speeding of conveyor get reduced. This is the single action which gives us a positive hope but it was not satisfactory or up to the benchmark.
6. We moves forward and erected 2nd Z loop at 2nd selected point 100mtr from the drive head. Over speeding of conveyor controlled and result was satisfactory.
7. To reduce the down time of particular conveyor we erected a loop take up arrangement at Seam III. (Ref. fig .5)

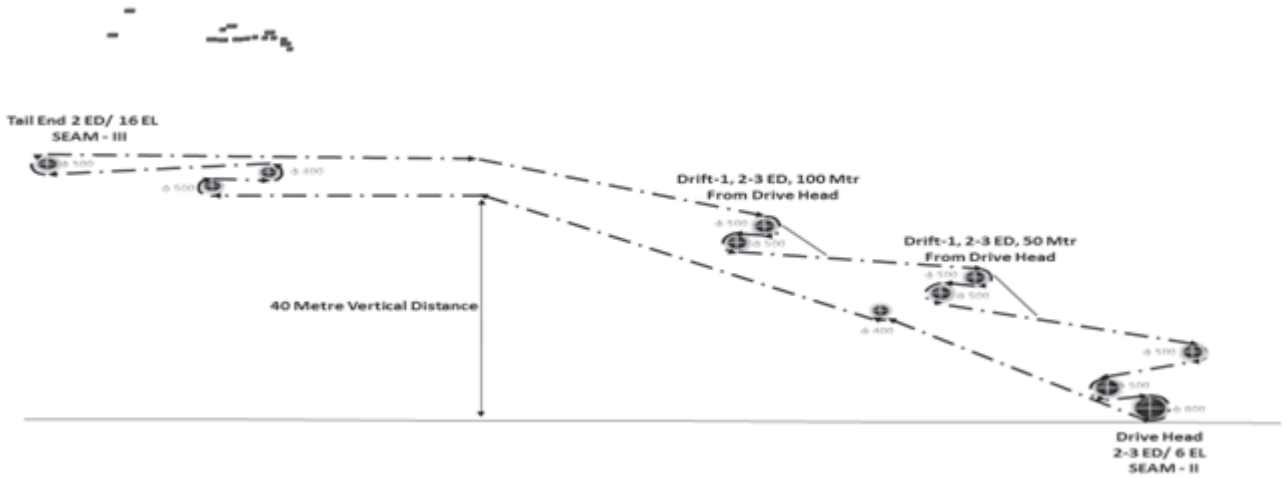

Figure 5: Seam III drift belt arrangement after implementation of CAPA

Risk review the hazard identified during development of SMP were reviewed after implementation of above and risk levels were recalculated. The review was done with the entire internal team under the active guidance of Regional DGMS officials. Calculated risk comes down as follow (Fig-6)

BENEFITS ARRIVED OUT OF CONTROL MEASURE

As per present layout belt was reinstalled or modified and following points has been observed:

1. Over speeding of belt is eliminated.
2. No spillage of coal noticed.
3. Ventilation improved as no chocking of coal in the drift occurred.
4. Safe Conditions created.
5. Operator stays at workplace comfortably.
6. Travelling road way have become safe to move without any danger.
7. Downtime reduced.
8. Desired production achieved from Seam III

Further brainstorming was carried OUT as risk level was still high and following ideas came

1. To Construct &develop In-seam bunker
2. Change in travelling path

HAZ No	HAZARD	MECHANISM	CALCULATED RISK				COM MEN
			CONS.	EXPS	PROB	RISK	
1	2	3	4	5	6	7	8
BCH-1	Belt Conveyor	Lack of knowledge on Process	0.3	10	7	21	
		Deployment of unskilled person	0.3	10	10	30	
		Operation by unauthorized Operators	5	10	7	350	
		Belt Snapping	5	10	7	350	
		Drive head structure failure	5	10	7	350	
		Failure of braking system	5	10	3	150	
		Tail end structure failure	1	10	10	100	
		Failure of take up arrangement	5	10	7	350	

Figure 6 : Snapshot of revised SMP RA sheet

ACTION TAKEN

For Inseam bunker's design parameters we have consulted with M/s A. Mukherjee & Associates, Kolkata. They have developed a drawing for in-Seam bunker having mass volume of 296 m^3. Construction work started in Jan 2017 by a third party M/s S. B. Engineering Associates, under supervision of Hindalco Industries Ltd. Technical parameters related to in-seam bunker are as follow:

Technical Parameters of In-seam Bunker		
Sl. No.	Parameters	Qty
1	Volume	296 m^3
2	Height of Bunker	42 mtr
3	Internal diameter of bunker	3 mtr
4	RCC	M 20 (1:1.5:3)
5	Thickness at collar	0.500 mtr
6	Thickness (Throughout)	0.200 mtr
7	Feeding Mechanism	Reciprocating feeder

Development of in seam bunker is decided to done by cutting of soft & hard rock using rock hammer and completed by November 2017.Subsequently belt drive heads & reciprocating feeder has been installed. Earlier coal evacuation system (Fig. 1) has been idle. Now coal evacuation is done through inseam bunker circuit as below (Fig. 7)

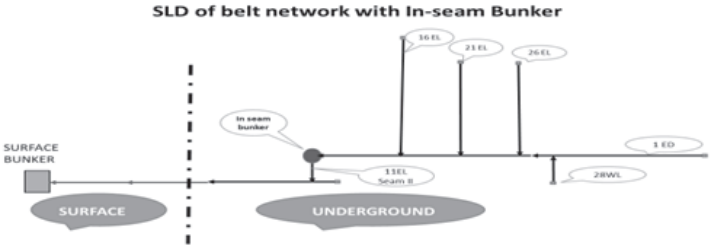

Figure : 7 SLD of Belt Network with in-seam bunker

BENEFITS ARRIVED OUT OF CONTROL MEASURE

In the risk analysis sheets all the hazards were eliminated by changing the coal evacuation system at particular place in the mine. And achievement due to SMP in this particular case is as follow:-

i) Risk of material evacuation in down gradient through belt was eliminated.
ii) Three numbers of belt became idle with the motor size 22KW, 55KW & 30KW.
iii) Running hour of main belt reduced by four hours.
iv) Total saving in power consumption per annum 413712KW and in terms of money saving is Rs. 41.37Lac/ Annum
v) 4200 man days per annum saved by reduction of deployment of belt operator as well as reduction in exposure as mentioned above.

Way forward: (1) Remote operation & (2) Level sensor installation.

SUGGESTION

The process of risk management must involve:

(1) the identification of all reasonably foreseeable hazards;
(2) assessing the risks arising from each hazard, developing a method of assessment that adequately addresses the hazards identified (this may include a risk analysis systematically using available information to determine the likelihood of a specific event and the consequences of such an event occurring and a risk evaluation which involves comparing the level of risk against pre-determined standards to determine the level of priorities to be allocated to each risk);
(3) the elimination of the hazards identified so far as is reasonably practicable and where it is not reasonably practicable to eliminate the hazard, minimise and control the risk so far as is reasonably practicable using the Hierarchy of Controls; and
(4) continual monitoring of the effectiveness of the controls implemented including processes for identifying, reviewing and responding to uncontrolled events.

CONCLUSION

Thus SMP is not only the tools for reduction/ elimination of risk even in stages but also beneficial in terms of cost reduction. Involvement of regulator as facilitator made it possible in elimination of above risk. The mine operator must ensure that risk management processes and procedures including risk assessments are implemented at the mine. Both economic and financial analyses of this mine in post reallocation of the mine rest upon a number of assumptions and predictions such as costs, prices and safety. The need for increasingly scientific approaches to the estimation of risk comes from the accelerating rate and quantum of investments in this project. The increasing scale of modern mining and the tendency towards the safe employment of work persons SMP is an important consideration in the planning, design and operation of mining engineering systems. Risk analysis is a compulsory element of all stages of mine feasibility studies, planning and production. The most promising approach to the quantification of project risk lies in the area of simulation and the development of methodology to adequately perform in them is growing. The intervention of managers and planners, for the better control of risk, is becoming more established practise, both in the simulation and operational phases of a project.

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Embracing the Beefits of Underground Retorting : Unique Method of Extraction of Liquid Fuels

R. Krishna* Besa Bunda**

ABSTRACT

Some natural hydrocarbons such as, oil shale and tar sand, having unique property, are found in solid state and contain liquid fuels and several useful by-products. The pyrolytic technique of destructive volitization is commonly referred to low temperature for oil shale retorting. The technique has been universally adopted for processing oil shale retorting is very simple process since it basically involves only the application of heat to break down the kerogen followed by removal and quenching of the volatile products. A promising novel method is suggested in this article which involves lower cost, causing minimal environment damage and yields at least 45 to 45 % more recovery than the traditional mining.

INTRODUCTION

Oil shale and tar sand (hydrocarbon deposits are unique, they contain kerogen and bitumen in solid state. These are minerallogically and petrographically fine grained marlstone containing insoluble solid organic substance. It includes oil, gas and carbon residue. Using chemical process known as pyrolysis, kinetics, and process control, kryogen is extracted in the form of liquid fuels and some very useful gaseous by- products. The unique nature of these solid hydrocarbons (Kryogen and bitumen) is fluidized simply by applying heat (815^0c). The oil bearing formation in – situ is subjected to combustion either electronically or by applying high temperature, high pressure gases orby liquids at 80^0. The retorted oil is collected at 70^0c.

Some of the advantages that underground retorting offers other than conventional extraction method are:-

- Makes the recovery of liquid fuels along with some gaseous by products at lower cost
- Method is technologically feasible
- Improved higher recovery (about 50%) more than traditional mining
- Environmentally friendly except for disposal of waste
- Reduced capital cost
- Take short time from design to construction to operation and, above all
- Low mainferance cost compared with alternative processing method.

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FACTORS TO CONSIDER

There are several factors that should be considered when selecting underground retorting. The first stage required is to test the amenability of chemical process of pyrolysis, Kinetic, and process control. In addition, two inherent characteristics of the oil shale: one, it's very low thermal conductivity which impedes heat transfer and two, its low porosity and permeability which may slow the fluid passage.

The poor permability of oil shale is the critical problem. This may require artificial fracturing and channels in the formation in order to retort oil shale in its place.

This can be done by modified in-situ retorting. The advantage of modified in – situ retorting is that this can be entirely from the surface, usually through boreholes. In the modified in-situ retorting permability of oil shale is increased by 30-40% simply by creating few voids in the oil shale deposit. The remaining oil shale is extracted by blasting using high explosives. This forms block and chambers in the oil shale that constitutes on underground retort.

Alternative to above, some specific mining methods can be employed such as, sub-level caving to creat the chambers. This method has the advantage that it can create several voids. Figure 5 shows a conceptual diagram created by sub-level caving.By using sub-level caving some special care have to be taken that the bocks are kept 50x50m in cross section and height f the blocks not exceeding approximately 200m.The modified in – situ retorting requires an appropriate type of underground mining method. For example, sub-level caving.

The distance between the adjacent sublevel face is calculated from the formula given below:

d=h+7.5 (m)

where d is equal to distance between the faces of the adjacent sublevels (m)

h = height of the sublevel (m)

and the distance d, is such that the roof caves beyond the line a-b. Mineral in productive faces is extracted by drilling and blasting. The blast design with deep holes have been found very effective.

EXTRACTION TECHNOLOGY

Sub-level caving system represents a system of mining which dispenses with supportat the working places. The sub-level caving systemis most widely employed in European countries, such as France for working steep coal seam. The section is developed by sub level gate roads driven along the strike at intervals of 7 – 17m in height. The developed sublevels are extracted in retreating order from the boundary of the section towards its middle. The upper sub-levels are extracted in advanced of the lower ones (Figure 1).

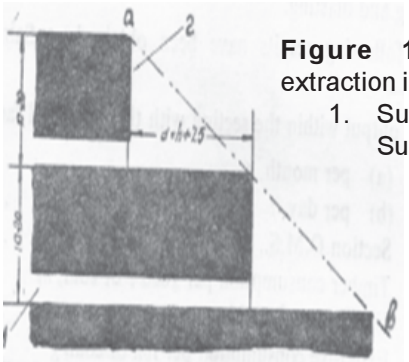

Figure 1. Succession of extraction in sublevels where
1. Sub-level gate road. 2. Sub-level pillars

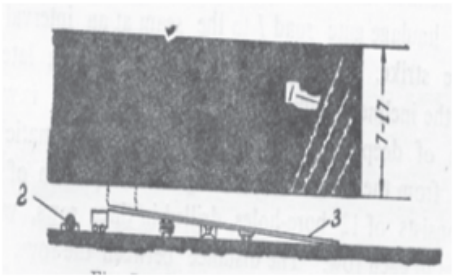

Figure 2. Getting coal from sub-levels where
1. Boreholes 2. Winch 3. Shaking conveyor

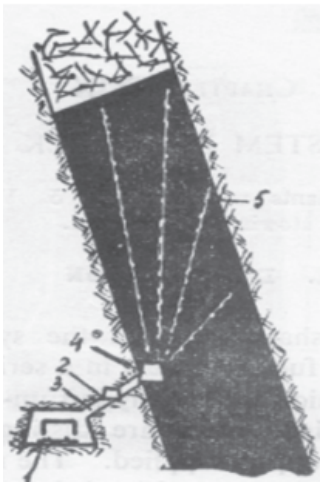

Figure 3. Patterns of deep holes in sublevel caving where
1. Lateral haulage gate road 2. Lateral ventilation airway 3. Inclined rock chute 4. Sub-heading 5. Longholes

Use of deep holes is found very effective owing to the low labour requirements. The times the miners are in the productive face in short which the system safe. There are one or two disadvantages such as difficulty in drilling and charging the boreholes and at times this may need secondary blasting.

In true, in – situ retorting massive fracturing is needed before retorting. This is done in either of the three ways, namely, the hydraulic or pneumatic method using high pressure fluid injection, using high voltage electricity or explosives generally slurries.

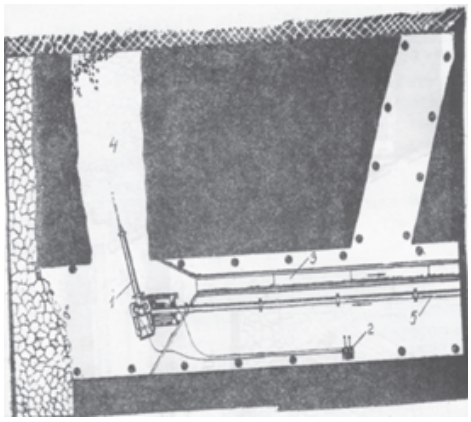

Figure 4. Hydro-monitor with remote control for breaking mineral where
1. Hydro-monitor 2. Control board 3. Flume 4. Jet 5. Water pipe

Despite of the disadvantages stated above, the sub-level caving system is a very effective method of working thick and steeply inclined strata which is generally in case of mining kerogen. In modified in – situ retorting process main and secondary development openings are driven to the block to be retorted. Single or multiple voids are excavated and the oil shale remaining in the places is blasted into (the voids excavated. All mining access opening are sealed and boreholes which serves as injection and production wells are drilled from the surface. The oil shales is then ignited from the top by burning fuel gas and process of combustion i.e. maintained by injecting fresh air. The burning zone progresses toward down through the retort. Thus, pyrolysis the oil which is collected from the bottom of the retort which then pumped to the surface has been shown in Figure5.

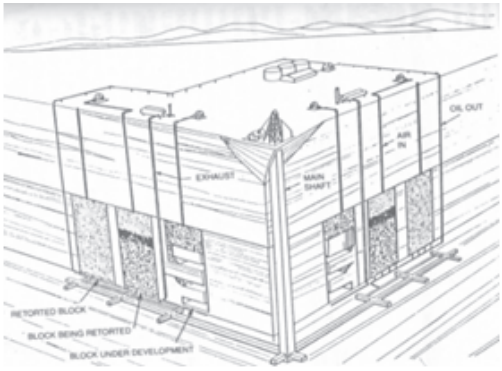

Figure 5. Conceptual diagram for retorting showing injection and production wells (after Jee, 1997.)

There are some more advantages of sub-level caving. This provide high degree of mechanization and no pillars are left for subsequent mining. The method is regular and permits systematic working. Development, production loading and drilling are carried out at separate levels, continuously and independently of each other. A large number of working places are always available for the different operations. The O.M.S. in sub-level caving is higher compared to some other similar methods. This is due to using hydraulic drifters (not pneumatic) and blasting using ANFO. Some mines for example in Kirunaan iron ore mine in Sweden have introduced self- propelled computer controlled LHDs.

Various processes for in situ retorting are available. The one concept described here (Russel et al 1981) is simple and works well over comes the problem of non-permeability of oil shell.

Five steps are involved for retorting as briefly described below:

1. Drilling three to five drill holes in which an insertion hole is ringed by production holed.
2. The zone where retorting be done is dewatered to make the environment dry.
3. The oil shale is fractioned to increase permeability and ignited by injecting hot fluid for combustion and pyrolysis
4. Compressed air in containing sufficient oxygen is injected through the injection well which begins to retort and finally
5. Retorted oil is pumped out through the production well.

Underground shale retorting is also done using a similar method called underground gasification. This method is based on the concept of partial combustion of oil shale using boreholes and the gaseous by products are collected at the surface. Underground gasification involves only three steps. (1) Two holes either vertical or including are drilled from the surface out of reach one works as in let for air and the other as the outlet for gaseous products, (2) oil shale is ignited using some source of heat, and finally (3) gaseous products come out through the outlet. Both boreholes, inlet and outlet are interconnected to constitute an underground gasifier **(Figure 6)**.

In modified retorting process four major zones are in counted l a burning underground retort; 1. Preheat zone, where the inlet gas is heated by the spent shale 2. Combustion zone, where oxygen is consumed by burning residual carbon 3. Retorting zone, in which kerogen begins to decompose and 4. Cooling zone, where the retorted oil and gas are collected at 70^0 Celsius.

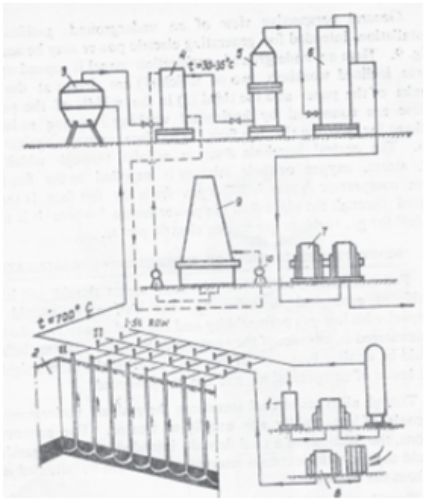

Figure 6. Technological scheme of underground gasification station where 1. Air compressor (5-8atm). 2. Underground gas generator. 3. Cyclone filter for dust. 4. Cooler-scrubber. 5. Electric filter for fine dust particles. 6.

H_2S recover. 7.Gas pump (1.5-2.0atm). 8. Low pressure air compressor. 9. Cooling tower. 10. Water pump.

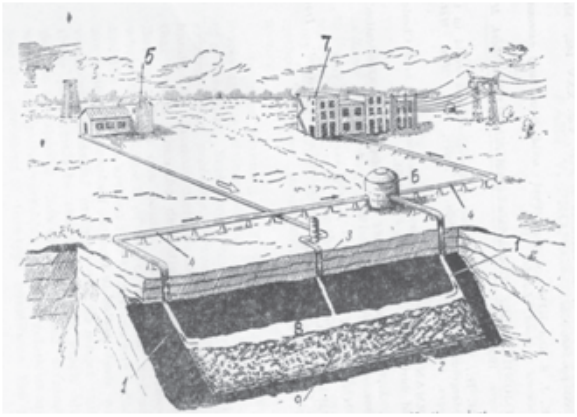

Figure 7. An underground gasification plant where

1. Flank boreholes. 2. Fire face 3. Inlet borehole. 4. Gas pipe 5. Compressor house. 6. Gas holder. 7. Power house. 8. Fire face. 9. Burnt out goaf.

FUTURE OF UNDERGROUND RETORTING

Modified in – situ retorting has undergone under through full – scale field tests and was found promising advanced technique to go to commercial operations. They appear quite feasible and economical.

To make this process economic the production must be on large scale. It is speculated that modified in – situ retorting process should be done at the surface with the oil shale containing 125 litres/tonne will yield 72,000 tonnes per day from approximately 20 blocks.

CONCLUDING REMARKS

Underground retorting could have a bright future in the mining industry. The occurrence of oil shale and bitumen in tar sand is throughout the world i.e. widespread. But because of economics its exploitation on large scale is limited. However, mining these at greater depth for improved grade this needs non – traditional methods. For this purpose, modified in – situ retorting has undergone full – scale field tests which has given promising results. The modified in – situ retorting the permeability of oil shale deposit i.e. increased substantially creating voids in the deposits for much various mining methods are available for example sub-level caving.This technology leads itself to treat lower grade materials and will find greater acceptance for oil fuels recovery. In few decades, we shall see a major potential for our second generation. In order to fulfil the rising costs in the coming years, this new technology will play a crucial role by providing sustainable process that will be economically viable and socially accepted throughout the world.

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Stability Analysis of Underground Coal Mine Pillars Using Numerical Modelling Techniques

Sreenivasa Rao Islavath*

ABSTRACT

Bord and pillar mining method is the oldest technique to exploit the underground coal deposit. This technique is equipped with semi mechanized mining machines such as load haul dumper (LHD) or side discharge loader (SDL) for loading the coal from the face and the conveyors for transporting the coal from the panel to the pit surface.

The semi mechanized operation is associated with more number of manpower deployments than the mechanized method such as longwall. In this method, the probability of occurrence of accidents is more from the roof or side fall. In order to avoid the accidents or fall of roof and sides, the condition of the pillars in the panel are to be determined. Hence, in this paper, a three dimensional numerical modeling analysis has been performed for the coal mine pillars of development panel. All the finite element models are analyzed considering an elastic behavior of the rock mass.

Keywords: Pillar, Stress, Strength, Safety factor and Finite element model.

INTRODUCTION

Bord and pillar mining is worldwide known method for exploiting the underground deposits. This technique is generally suitable for thin and medium seams. This technique is also popular for extraction of thick coal seams by adopting the two lift system. The most of the underground coal mines in India are practicing the bord and pillar method.

In this method, a virgin coal seam is extracted in two steps, they are i) development and ii) depillaring phases. In the development operation, pillars are formed after driving the network of road ways along the parallel to the strike and perpendicular to strike (or parallel to the dip). The level or perpendicular road ways driven to the strike are called as level and dip galleries. In this stage, around 20 to 30 percentage of coal is extracted. In the depillaring stage, the pillars formed are further reduced by driving the level gallery in the pillar and this gallery is known as split gallery. The two half pillars (upper or lower half) are formed by the split galleries are known as stook. Each stook are again reduced with split and slice method [1].

The bord and pillar method is associated with more number of accidents due to roof or side falls in India and other countries. It is necessary that numerical modeling analysis have to be performed to minimize or avoid the mine accidents. In this study, a coal seam of 4.23 m thick located at159.07 m depth is modeled for the stability analysis of the coal pillars of development panel. A total of two three dimensional numerical models are developed to do the stability analysis.

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DESCRIPTION OF THE MINE SITE

A bord and pillar panel of GDK 10A incline, SCCL located at a depth of 160.30 m depth from the surface is under extraction with Load Haul Dumper technology. A coal seam of 4.2 m is developed in the bottom section with 3 m thickness. The strata lying above the coal seam is shale of 1.6 m thick and below the seam is sandstone. The panel is developed with the sixteen pillars of size 40 m x 40 m and gallery of 4 m size. The model is developed based on the lithology given in the Figure 1 [2].

THREE DIMENSIONAL NUMERICAL MODELLING

Two 3D-finite element models have been developed based on the mine site lithology (Figure 1). The models are analyzed to estimate or determine the stress concentrations around the pillar and gallery. All 3D models are analyzed considering elastic behavior of the rock mass. The three dimensional models are describes as follows:

I. In-situ model consists of virgin coal seam and surrounding rock mass (shale and sandstone).
II. Excavation models consist of pillars, galleries and surrounding rock mass.

Development of Model

Three dimensional finite element models are developed based on the lithology given in the Figure 1. The coal seam is developed with thirty six pillars having fourteen galleries (of which seven levels and sevel dips) as shown in Figure 4. The outer lines of the pillars (20 nos) are considered as barriers. The rest inside sixteen pillars are considered for depillaring operation. The size of the entire panel or model is 350 m x 350 m x 188.3 m. The size of the each pillar is 40 m x 40 m and size of the gallery is 4.2 m x 3 m. Figure 2 and 3 shows the Insitu and excavation models.

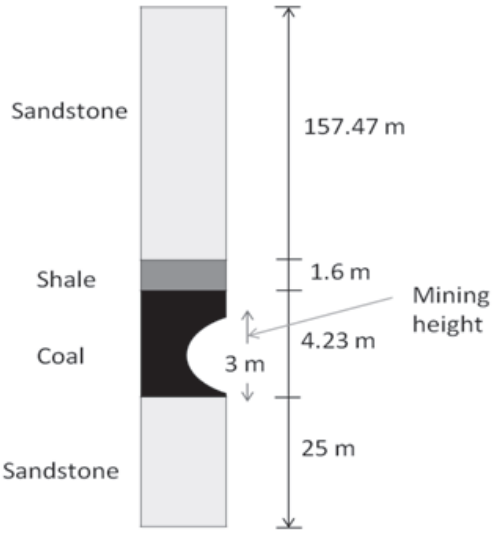


Figure 1. Lithology of the mine site used for Finite Element Model

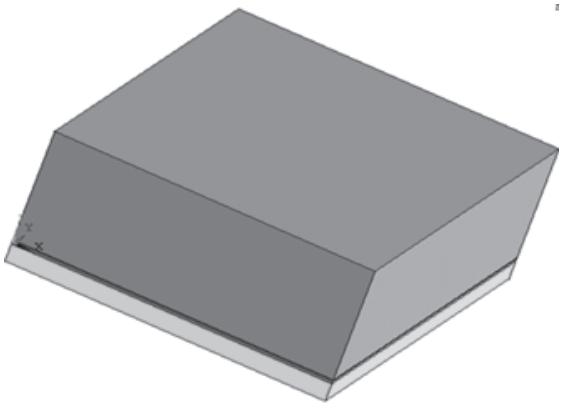


Figure 2. Insitu model

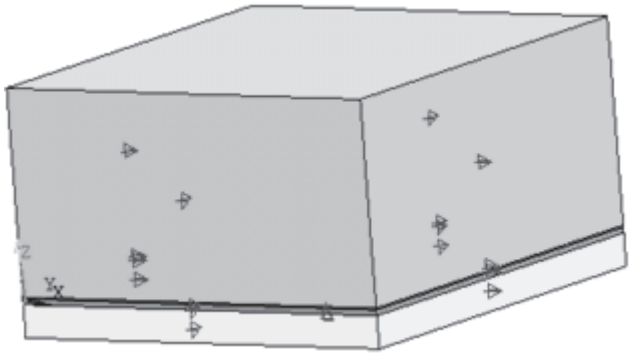


Figure 3. Developed panel

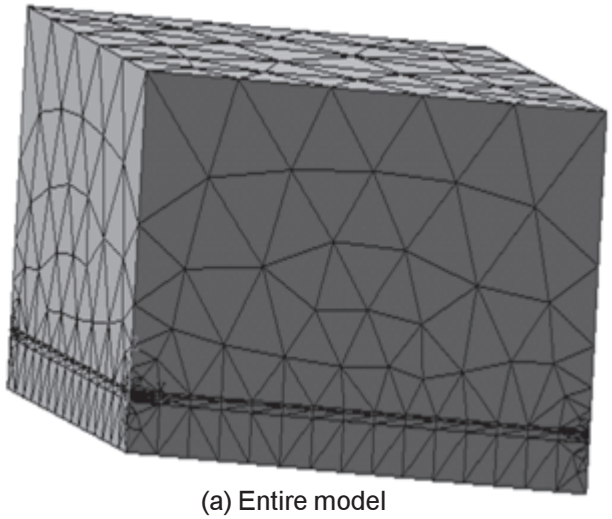
The rock mass properties such as elastic modulus, poison ratio and density are collected from the mine site and listed in the Table 1. These properties are applied to the finite element models for the further analysis.

Table 1. Rock mass properties used for FEM [2]

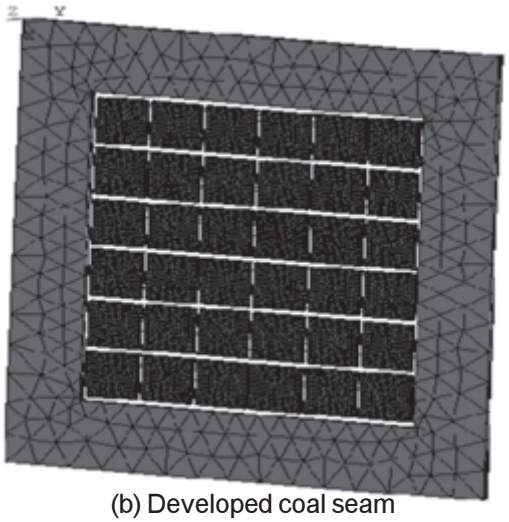
Rock type	Modulus of elasticity (GPa)	Poisson's ratio	Density (Kg/ m^3)
Coal	1.25	0.35	1300
Sand stone	5.5	0.25	2400
Shale	3.3	0.3	2280

Generation of Finite Element Meshed Model

The insitu model produces an average of 7349 8 - noded tetrahedron elements and 11,352 nodes and the excavation model produces 218352 8 - noded tetrahedron elements and 296921 nodes. Figure 4 shows the meshed model of entire panel and developed coal seam.



(a) Entire model



(b) Developed coal seam

Figure 4. Meshed model

Boundary Conditions

The entire size of the model is 350 m x 350 m x 188.3 m are applied boundary conditions along strike and dip directions and bottom of the model as shown in Figure 5.

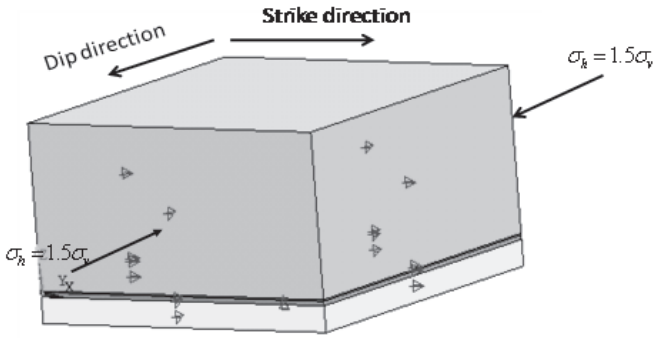


Figure 5. Boundary conditions are applied

The model along the strike directions and bottom of the model are constrained and the perpendicular directions or dip directions are applied horizontal stress using equation 1. The model is also applied the gravity load in the vertical direction.

The horizontal stress is calculated as shown below [3,4, 5].

$$\sigma_h = 1.5\sigma_v \qquad (1)$$

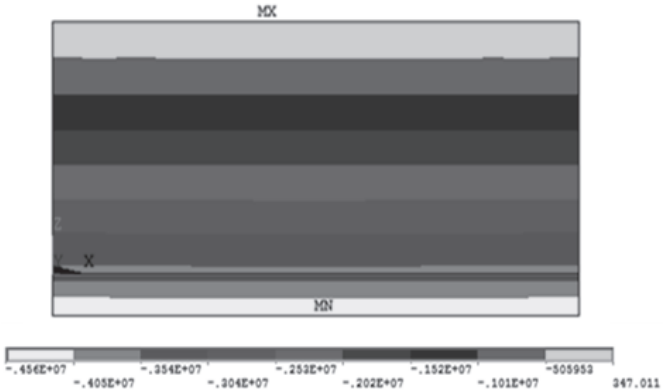
where, $\sigma_v = \rho g h$, σ_h = Horizontal stress applied along the dip of the coal seam (MPa), σ_v = Vertical stress (MPa), g = Gravity load ($\frac{m}{s^2}$), h = depth from the surface (m).

RESULTS AND DISCUSSIONS

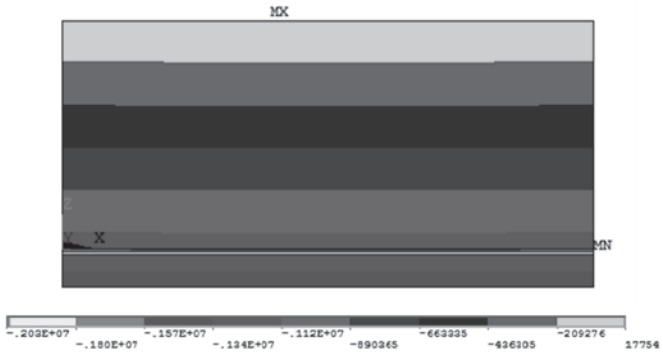
The results in terms of principal stress distributions around the pillars and galleries are presented. The safety factors of the coal pillars of development panels are estimated based on Bieniawski formula.

Principal Stresses Distribution

The major principal stress distribution varies between 0.5 Mpa to 4.5 Mpa and the coal pillars are experienced with 3 to 4 MPa as shown in Figure 6a. The minor principal stress distribution varies between 0.2 to 2 MPa and it is found that the coal pillars are experienceing the minor principal stess of 0.9~1.2 MPa as shown in Figure 6b.



(a) Major principal stress



(a) Minor principal stress

Figure 6. Principal stresses distributions

Factor of Safety

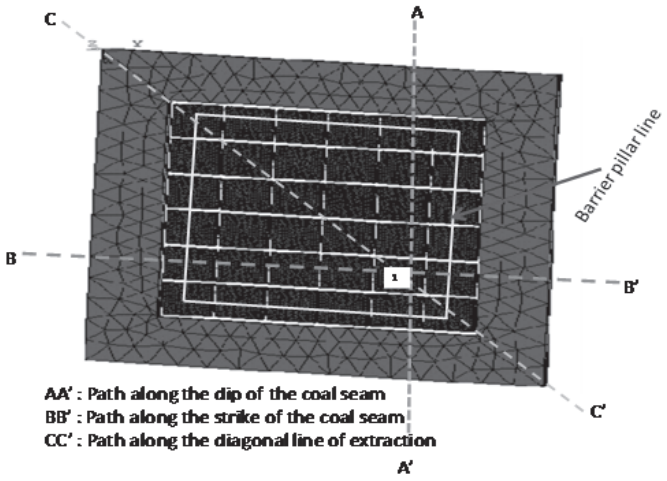


Figure 7. Paths considered along AA', BB' and CC'

The safety factor of the pillars are estimated to know the pillar conditions. The safety factor of the pillars is a ratio of strength of the pillar to stress acting on the pillar. The stress and strength of the pillars of panel are determined using tributary area method and Bieniawski formula respectively [3-6].

$$SF = \frac{S_p}{\sigma_p} \qquad (2)$$

According to Bieniawski , the strength of the coal pillar (S_p) is determined using equation 3.

$$S_p = S_1(0.64 + 0.36\frac{W_p}{m}) \qquad (3)$$

The stress acting on the pillar (σ_p) is determined based on tributary area method as given below.

$$\sigma_p = \frac{\sigma_v(W_p + W_o)^2}{W_p^{\,2}} \qquad (4)$$

From the above equation 3 and 4, the equation 2 becomes as follows.

$$= \frac{S_1(0.64 + 0.36\frac{W_p}{m})}{\frac{\sigma_v(W_p + W_o)^2}{W_p^{\,2}}} \qquad (5)$$

where, S_p = Strength of the pillar, σ_p = Stress acting on the pillar, W_p = Width of the pillar (40 m), W_o = Width of the opening (4.2 m), m = Mining height (3 m), S_1 = 7.5 MPa and σ_v = Vertical stress (MPa).

The safety factor of the pillars lying along the paths AA', BB' and CC' are estimated using equation 5 and listed in the Table 2. Pillars numbers starts from 1 to 4 towards the paths.

Table 2. Safety factor of the pillars

Paths	Pillars	Average Stress (M Pa)	Strength of the pillar (M Pa)	Factor of safety
Along the path AA'	1	3.12	27.8	7.21
	2	4.55	27.8	*4.95*
	3	3.66	27.8	6.15
	4	3.46	27.8	6.50
Along the path BB'	1	3.81	27.8	5.91
	2	3.75	27.8	6.00
	3	3.64	27.8	6.18
	4	3.58	27.8	6.28
Along the path CC'	1	3.81	27.8	5.91
	2	3.61	27.8	6.23
	3	3.11	27.8	7.23
	4	3.73	27.8	6.03

The safety factors of the pillar in the panel are found between 4.95 and 7.23. These pillars do not fail during the development operation. Safety factors of the pillars are reduced during the depillaring operation. They may yield in the depillaring stage.

CONCLUSIONS

From the three dimensional numerical study, maximum stress concentration occurs at the corner of the pillar and minimum at the centre of the pillar. It is also observed that the maximum vertical stress is found to be 4.3858 MPa. The minimum safety factor along the paths AA', BB' and CC' are found to be 4.95, 5.91 and 5.91 respectively. The maximum safety factor along the paths, and are found to be 7.21, 5.91 and 7.23 respectively.

It is observed that the safety factor of pillars lying along path is less than other two paths. These pillars do not fail during the development stage as the safety factors of the pillars more than one; however they may fail in the depillaring stage as split and slice method is adopted for extraction of the pillar. Hence, proper supports have to be installed in the roof or between the roof and floor to keep the panel safer.

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How Regulation Twists to Empower "Inspector Raj "

Chand Chandna*

How the Act,Rules and regulation states are legally twisted to empower the "Inspector Raj" for the compliance of regulations ignoring the justice to the safety norms.

(1) As Prescribed in section 17 of the mines Act 1952,every mine shall be under a sole manager who shall have the prescribed qualifications" and the owner or agent of every mine shall appoint a person having such qualifications to be the manager. Provided that the owner or agent may appoint himself as manager if he Possesses prescribed qualifications.

(2) The mines Rule 1955 defined manager U/ Rule 2 (f) state as "manager " includes mine superintendent who is appointed by the owner or agent of a mine U/Section 17 of the Act and as such responsible for the control, management or supervision and the direction of a mine.

(3) The metalliferous mines Regulation 1961 again defined the "manager " U/Regulation 2 (16) states as "manager" means a person possessing the prescribed qualifications and appointed in writing by the owner or agent to be in- charge of a mine under the Act and includes a mine superintendent if Appointed U/Section 17.

>>> It is quite obvious from section 17 of mines act 1952, and defined under mines Rule 2(f) of 1955 and the regulation 2(16) of metalliferous mines Regulation 1961 , that the "manager " must possesses the prescribed qualifications.

For the required prescribed qualifications& examinations the following Regulations are framed in the metalliferous mines regulations 1961 which are as under :—

(1) For the required qualifications and examinations, A Board of mining examination is framed U/Regulation 11 of the metalliferous mines regulation 1961.

(2) Competency certificates are granted U/regulation 12 (a) states as certificates under these regulation shall be granted by the Board.
Regulation 12 (b) states as "certificates granted by the Board shall be valid throughout the territories to which these regulation extend and shall be of the following kinds
Regulation 12 (b) (i) states Manager's first class certificate of competency to manage a Metalliferous mine (in these regulation referred to as a First Class Manager's certificate).

(3) The regulation 13 of metalliferous mines regulation 1961 states as- Certificates of competency shall be granted to successful candidates after such examination and in such form as the board may prescribe.
[Provided thatthe Board may, subject to the conditions to be specified in the bye-laws framed for the purpose, exempt any person from appearing at the examination or part thereof for grant of a certificate referred to in Regulation 12]

(4) Regulation 34 (1) (a) of metalliferous mines Regulation 1961 states as—No mine shall be opened, worked or reopened unless there is a manager of the mine being a person dully appointed and having such qualification as are required by these Regulations.

(5) Part of Regulation 34 (2) empower the inspector stating > except as hereafter provided in sub-regulation (6) and subject to the provisions of sub-regulation (3)
Provided that no person shall act or continue to act or be appointed as manager of a mine or mines where work is being carried on by a system of deep hole blasting and/ or with the help of heavy machinery for the digging, excavation and removal, etc. of earth, stone, mineral or other materialunless he holds a First Class Manager's Certificate.

>>> It is how the regulation twisted to empower the "Inspector Raj" and gives legal waysfor inviting corruption under regulation 34 (6) states as "The chief Inspector may , by as order in writing and subject to such conditions as he may specify therein, authorize any person whom he may consider competent to act as manager of any mine or mines for a specified period, notwithstanding that such person does not possess the qualifications prescribedin that behalf by sub-regulation (2) and may by a like order revoke any such authority at any time".

>>>>>A Person does not possess the prescribed qualification under regulation but an inspector authorized any such person whom he may consider competent to act as manager of mine or mines, means the person must be

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of inspector's choice at his will makes the inspector raj empowered in the regulation 34 (6) even ignoring the regulation 34(3) to consider the lower qualification of manager as prescribed in regulation 34(3).

Even more the specific regulationprovided strictly to observe in regulation34 (2) states as "provided that no person shall act or continue to act or be appointed as manager of a mine or mines where work is being carried on by a system of deep hole blasting and / or with the help of heavy machinery for digging, excavation and removal etc. of earth, stone, mineral or other material unless he holds a first class manager's certificate". It is observed,This regulation is also mostly ignored by allottingpermission of even two digging excavators of 200 HP each (200 HP shovel is a digging& excavating heavy earth moving machinery) to run any shift of workings. Under regulation 34(6) authorizing a manager to a person not possessing any prescribed qualifications of mining operations under regulation, nor reduced qualification of manager u/ Regulation 34 (3),Is a quit obvious example of empowered of"inspector Raj". It is also to be noted that the deployment of machinery automatically reduces employment minimum. So in case of deployment of machinery the deployment of labor is not a criteria but the machinery HP is the consideration for the category of manager to be appointed as stated in regulation 34(2)

If competency of a manager is judged by an inspector of his choice and will, in the regulation then the previously mansions regulations and forming mining examinations board and conducting qualifying examinations on India level and issuing certificates on passing examsare of no importance and of novalue when competency is judged by a inspector'schoice & will, beyond the required qualifications prescribed in the regulations.

When the choicer person of the inspector not possessing the prescribed qualifications will be authorized as manager under regulation 34 (6) then what will be the future of the qualified persons those wondering here and there looking for the jobs to build their future. Such "inspector Raj" humiliate the qualified person and gives the opportunity to authorize unqualified person to enjoy as mine or mines manager on the choice and will of the inspector, keeping on terror to be"revoke any such authority at any time" to keep alive the corruption as legally provided in the regulation 34(6).

The central Government of India framed the Metalliferous Mines regulations 1961 under section 57 of the mines Act 1952 considering concession to authorize any such person does not possess the qualifications prescribed in regulation 34 (2) to act as manager of any mine or mines under regulation 34 (6) and a person holding lower qualification permitted permission in writing with conditions under regulation 34(3) by the regional inspector as chief Inspector delegate his powers under section 6(1) to regional inspector to exercise such of the powers of the chief Inspector, authorise at his choicer competence person.

This concession may be consideredunder section 57 (g) for the small stone quarry holders those are earning their bread and butter by deploying daily wedges labors on a small scale of earning without using any digging and excavating machinery,may not be so profitable to deploy a high ranged qualified manager or engineer which is presumed as not defined in Act & regulation as which mines covered in regulation 34(6) &34(3) to be considered to be appoint manager as concession consider in regulation 34(2)

As the natural law of justice consider the concession under section 57 (g) of mines Act 1952 for determining the circumstances ofweaker section considering the small mines to be covered under these regulation 34(6) &34(3) for the appointment of mine or mines manager are framed. But specific guide lines are not framed and left on the consideration of the regional inspector to authorize the manager of Any mines under regulation 34(6) & 34(3) at his choice.

In absence of guide lines no one to come forward to share the pity conditions of small mines workings, closing day by day and the daily wedges labors becoming jobless and wondering for their survival. Lacking of guide lions no small mines getting relief and their mines are not so economical to deploy manager of prescribed qualifications. Small mining is mostly a lineage deed of the poor villagers to earn their bread. So differentiate the Small working and the big mine workings and as such differentiate application of rules which will be only feasible.

As such these regulations must wisely be explained and perfect guide lines should be fore worded to provide relief to small manual mines and to appoint qualified managers & engineers at the deserving mines and removing the "Inspector Raj"to make use of their choice with legal protection of law.

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Environmental Management in Cement and Limestone Mining Projects Industries of Meghalaya

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North Eastern region is one of the biodiversity hotspots of the country and there are conservation challenges during development. Threats have increased and protected areas are under tremendous biotic pressure. Adaptation and mitigation measures are required to be inbuilt in the development process. Therefore, there is pressing need for a collective approach to deal with environmental deterioration issues and impacts. We should develop mechanism for discussion on planning and environmental management issues relating to developmental activities here are problems in mining sector which may create serious impact on the people and the natural ecosystems. There should not be extraction of natural resources beyond the capacity of region. The periphery of sanctuaries and protected areas are under pressure. The Regional Office, MoEF&CC, Shillong, has also observed that several projects are not complying with certain Environmental Clearance (EC) conditions especially concerning ecological and technical issues due to lack of expertise. With this background, the regional office organised a meeting by inviting senior executives and environmental officers from cement and limestone mining projects in the state of Meghalaya, subject area experts from different Universities and Institutes of NE region and other parts of country.

Dr. V. P. Upadhyay, Scientist 'G' Regional Office, MoEF&CC, Shillong briefly discussed the objective of the meeting. The cement and limestone mining projects located in the state of Meghalaya are to make efforts to implement various environmental safeguards for conservation and protection of local flora and fauna, ex- situ and in situ conservation of endemic/threatened species and carry out study on impact of particulate emissions/fugitive emissions on the surrounding forest, utilization of high calorific hazardous wastes and waste heat in the cement plant and environment impact of blasting in limestone mining projects and benefit of new technologies like surface miners.

He focussed on poor level of compliance in cement industries and mining projects in respect of implementation of safeguards like rainwater harvesting scheme in consultation with CGWA, treatment of the upper catchment of the mine lease area, monitoring studies on the collapse of caves and cavities around mine lease area along with blockage of sub-surface water channels, in situ and ex situ biodiversity conservation measures, implementation of public hearing recommendation and submission of yearly report on environmental statement. Most projects are yet to fulfil the commitments made during public hearing. He urged the projects not to deprive the people of their rights and fulfil the commitments made during public hearing. He explained that environmental audit helps the project to reduce the losses and projects become more efficient with respect to resources and energy use. Adoption of new extraction technology may overcome the ill effects of drilling and blasting operations at mining sites, such as noise, dust, vibrations, fly rock formations, eliminating crushing related infrastructure, which are the source of loud noise, dust and vibration in mining areas. He emphasized the need for viable options like the use of techno-economically feasible surface miners, which do not require secondary crushing and improve the quality by selective mining, and prevent the air and water quality deterioration from chemical enrichment of blasting. Further, the minerals can be mined up to boundary of mine which would have otherwise been locked up due to blasting restrictions. A comprehensive study of limestone deposits in Meghalaya with respect to the feasibility of surface miners was suggested by National Institutes of repute to find out the ways to eliminate the ill effects of blasting on fragile ecosystem including human population. There are increasing uses of surface miners in several mines of the country.

With respect to cement plants, there are safeguards stipulated in EC for use of Alternate Fuel and Raw materials (AFR) and high calorific hazardous waste in cement kiln, development of greenbelt to mitigate the effects of air emissions and rainwater harvesting, recharge and use of harvested rain water, conservation of local flora and fauna, separate EMC with full fledge laboratory facility. These safeguards are yet to be satisfactory complied in most of the projects. He opined that conservation plan should be implemented in collaboration with reputed institutions. Dr. Upadhyay gave the example of NEEPCO, where ex situ conservation with the help of BSI was done in their Kopili project. No project has taken up any study on conservation of wild fauna, which was to be completed within a maximum period of 1 year from the date of EC including a comprehensive conservation plan for threatened and endemic species in consultation with BSI.

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With respect to AFR use in cement kills, the wood wastes and saw dust from saw mills in North East, oil sludge, municipal biological and plastics wastes, spent catalysts from refineries, outdated health products, paper mill waste, ETP sludge from industries may qualify as AFR for use in cement kiln. He further stressed the importance of waste heat recovery in cement industry which has not started in NE region. Around 35% of the energy in cement kiln is lost. The change in ambient temperature would result in species shift, changes in the reproductive behaviour of the plants and animals, and changes in the flowering season etc. The projects must implement waste heat recovery technology to help mitigating the 'heat island effect' being created by cement cluster in a ecologically sensitive region with number of threatened and endemic biodiversity.

Professor S. K. Tripathi, Department of Forestry, Mizoram Central University focused on biodiversity and how the degradation of land uses may result on the loss of biodiversity, increased emission of biogenic gases like CO_2, CFC, CH_4, NO_x, changes in global C and N cycles and ozone layer depletion. He explained forest biodiversity from a multidimensional aspect, showing examples of organisms of food webs. He further explained the linkage between biodiversity and human health, citing published reports that the total value provided by the Ecosystem Services was of US$ 33 trillion. To show the impact of cement industry on biodiversity, he mentioned that approximately 755 kg of CO_2 is released from every ton of cementatious product mainly from the clinkers, while NO_x is emitted due to fuel consumption at high temperature. Dr. Tripathi opined that recovery and rehabilitation program is required to mitigate the problem. Rehabilitation program may include buffer sites, wetlands, and community biodiversity projects with emphasis on propagation of endemic species under stress and plantation activity may also mitigate the amount of CO_2 emitted from the industry. Central University Mizoram is fully equipped with expertise to take up Biodiversity Assessment and restoration programme for industrial areas of NE region. Long term collaborative programmes with other Institutes of North East Region for Regional/cluster level studies in cement project areas will be appreciated.

Dr. A. A. Mao, Botanical Survey of India(BSI), Zonal Office, Shillong gave an idea about the expertise and services BSI can provide to the projects. BSI can do an assessment of the plant species, ex situ and in situ conservation including indigenous species plantation at the project site. He informed that BSI has developed a repository of the germ-plasm of wild plants in their Barapani research centre. Dr. Mao advised the projects to contact BSI for any such expertise concerning EC conditions which can be initiated under project modules.

Dr. R.K. Borah, from Rain Forest Research Institute (RFRI) Jorhat presented the facilities and expertise available at RFRI Jorhat, their research mandate, funded projects, completed and ongoing projects and important research achievements. Important research highlights included assessment of biological diversity of various ecosystem of Kaziranga National Park, studies on structural formation of vegetation in Gibbon Wildlife Sanctuary, ethno-medico-botanical studies of Khasi, Garo and Karbi Tribes, medicinal Plants in Nambor Reserve Forest, and ethno-medico-botanical studies of Nepali community in Assam etc. RFRI can take up biodiversity monitoring and evaluation activities and welcomed the project to avail the expertise of RFRI for implementing the environmental safeguards of EC in an around the project area that will ensure Biodiversity sustainability.

Shri Amit Sharma and Ms Richa Tyagi from WWF, stressed upon the need to conserve the world's biological diversity, use of renewable natural resources and reduction of pollution and wasteful consumption to build a future in which humans live in harmony with nature. The conservation works/ activities carried out by WWF India in the North Eastern Region was also highlighted. Ms Tyagi emphasized on the need for use of primary data in EIA report to make it a quality report.

Professor G K Pradhan, AKS University, Satna, MP gave an insight on eco-friendly mining techniques. He emphasized the several ill effects of blasting such as security problem in transportation, storage, handling and use, environmental impacts vibration, air blast, fly rocks etc. The solution to eliminate these impacts includes blast free mining techniques, which are cost effective, safe, requires less man power, resulting in higher productivity, reduced CO_2 emissions, and unlimited production capacity. Examples of the blast free mining techniques that was mentioned include 1) ripper-cum-dozer; 2) continuous surface miner (Wirtgen miner, Vermeer, Trencher); 3) Rock Breaker. There is loss of huge quantity of unutilized explosive energy during blasting and we need to explore alternatives to practice "eco friendly" blasting. Additionally, CO_2 emission is associated with all mine operations. According to Dr. Pradhan, 1kg of explosives produces 167.3 kg of CO_2, 16.3 kg of CO, and 3.5 kg of NO_2. Professor Pradhan ended the presentation by emphasizing on the need to reduce the carbon footprint, by reducing explosive consumption. Dr. Pradhan informed that his University along with IIT, Kharagpur can take up feasibility study for "Surface Miner" in Limestone Mining Region of Meghalaya which can be coordinated by regulatory authorities.

A presentation on the use of AFR in cement kiln was made by Shri Akhileshwar Upadhyay from Ultra Tech Cement Ltd. He informed that cement kilns ensure complete destruction of all harmful pollutants, emitting negligible particulate emissions, absorbs SO_2 and neutralize acid gases. He informed that co-processing is a fully recognized process. He discussed on the type of waste that can be co-processed, how it can be handled, and list of banned wastes. He ended the presentation by concluding that the project can use AFR in cement kilns to derive several economic as well as environmental benefits.

Shri Kanan Vairavan, CII Counselor he talked on "Promoting Alternate Fuel and Raw material (AFR) utilisation in Indian Cement Industry". He introduced the Confederation of Indian Industry (CII), which is a non-government, non-profit, industry led and industry managed apex industry association founded 120 years ago. Shri Vairavan pointed out that cement industry in India emits 137 MT of CO_2, which is 7% of India's total man made emissions. Therefore, the use of AFR in cement industry would result in the reduction of greenhouse gas emissions. Additionally, he mentioned that with municipal solid waste generation reaching 140 million tons by 2025, co-processing in cement industry will be a sustainable solution for waste management, resulting in the reduction of overall greenhouse gas emissions. He also informed that CII supported by Shakti foundation facilitated the use of urban and industrial waste as AFR in Indian Cement industry through policy advocacy and technical research and analysis. CII have brought together waste generators and cement plants alongwith State PCB and other stake holders of eight states.There have been some achievements in use of AFR in cement kiln in other parts of the country. However, this initiative is lacking in cement industry of NE region. Thermal Substitution Rate(TSR) is far less in India compared to 45-80% in some countries. TSR of 10% has the potential to reduce CO2 emission 0.2% of 2007 emission (3 MTPA of CO2 equivalent) of the country. Therefore, use of AFR in kilns need to be implemented as stipulated in EC.

An example of successful use of AFR in cement kiln was presented by Shri P. Chakravarty of Calcom Cement India Ltd by the use of saw dust along with Pet Coke/ Coal as AFR in the cement plant located at Umrangshoo village, Assam. He informed that on usage of 3.6% AFR, the company has earned to date saving of approx. Rs 1.3 Cr on TSR basis. Dr. Shantanu Datta, CPCB emphasized on the importance of co-processing in cement kiln and stated that the process of co-processing has several benefits which includes total avoidance of land disposal or incineration of waste, no future liability for waste and associated problems, no investment on developing TSDF, reduction in green house gases emission and related benefit, conversion of waste into energy, reduced burden on TSDF, conservation of fossil fuel and raw material resources, immobilization of toxic and heavy material and reduction in energy / cement production costs etc. He informed that authorization as per the provision of the Hazardous Wastes & Other Waste (Management & Handling) Rules, 2016 for using AFR in the cement kilns from the respective SPCB is also needed.

Dr. Shantanu Dutta gave a brief introduction of plantation by Akira Miyawaki model. He mentioned on how the plantation is done and model plantation carried out at various Industrial location in Assam and Meghalaya. He informed that the survival rate of the sapling is more than 90% compared to the general plantation where the survival rate is less than 25 %. Miyawaki model has also been applied in iron ore and chromite ore mining regions of Odisha with similar results.The plantation does not require much after care, weed growth is negligible, digging of large pits is not necessary, moisture retention is high and mulching helps in preserving soil nutrients and prevents erosion. As a result, it is a cost effective method. The cost of plantation is borne by the project itself. Therefore, ecological stability at faster rate is the prime concern. Shri Amit Sharma from WWF opined that CAMPA scheme may adopt the Miyawaki model in a plot size study. Dr. Upadhyay appreciated all projects for their initiatives for developing the Miyawaki model of plantation at their project site. It was also emphasized that the project must encourage local people to develop nursery of local plant species and all nursery plants should be purchased by the projects. Initial cost for developing infrastructure must be borne by the project of the area.

The last presentation was made by Shri N. K. Dey, Indian Oil Limited (IOC), Bongaigaon Refinery. He dealt on the characterization of oil sludge from tank and ETP holdings in lagoons for possible use as AFR in cement kiln. He also informed that raw petroleum coke (RPC) can also be used in cement kiln. The projects were requested to discuss the matter with IOC and finalize the agreement in consultation with Pollution Control Boards for use of oil sludge as AFR in cement kiln.

There was discussion after these presentations among projects and experts relating to various safeguards and taking up projects/programmes to increase the level of Environmental Compliance. The projects were advised to prepare time bound action plan and implement these safeguards with the help of reputed Institutions. The Institutions should also develop mechanism for helping NE States in Eco-restoration of degraded areas by involving them in identification and providing recommendation of suitable species for regeneration of lands and water bodies degraded due to biotic pressure and developmental activities.

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