A Quarterly Publication

# THE MINING, GEOLOGICAL AND METALLURGICAL INSTITUTE OF INDIA

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# MGMI News Journal

Theme:
Health
Safety and
Environment
in Mining &
Allied Industry

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July - Sept. 2020

# MGMI COUNCIL FOR 2020-21

THE MINING GEOLOGICAL & METALLURGICAL INSTITUTE OF INDIA
1906
Established 1906

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**Dr Ajay Kr Singh**, Former Scientist, CSIR-CIMFR

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# MGMI NEWS JOURNAL

ISSN 0254-8003

Vol. 46, No. 2, July-September 2020

# *A herritage Institute with glorious history*


***Rstablished: 1906***

**The Mining, Geological and Metallurgical Institute of India**
GN-38/4, Sector V, Salt Lake, Kolkata 700 091
Phone : 2357 3482 / 3987, Telefax : 2357 3482
E-mail : mgmisecretary@gmail.com, mgmihonysecretary@gmail.com
Web : www.mgmiindia.org

***Serving the Indian mining , geological and mineralogical world sinc 2006, MGMI today is an institute with more than 3000 members. The Institute has an illuminary spectrum of professionals from all areas related to mining engineering, earth sciences and mineral engineering.***
***The Institute is proud of having leaders from the mineral based industries, technocrat planners and policy makers from both in the private and public sector at State/Central levels, experienced managers from different sub-disciplines ranging from evaluation of resources to their eco-friendly exploitation as its esteemed members. Academicians/research scientists and students from geology, mining and metallurgy as well as the chief executives of most of the organisations related to mines and minerals in India are also amongst the institutes members and policy makers.***

***Prior to Independence, the Government of India used to seek suggestion/comments of the institute in wide ranging issues from "induction of safety measures in underground mines" to "income tax" slabs for small scale mines. The practice continued in post-independence era. The Institute is always invited in major policy decisions by the GoI to contribute directly or indirectly.***

## OBJECTIVES

*To advance and protect the interest of the mineral industries and the welfare of those engage therein and to assist maintaining an honourable practice in the professions of Geology Mining, Metallurgical and allied subjects connected with the mineral industry of the country.*

## *Events & Activities*

*MGMI fulfills its objectives to encourage, assist and extend knowledge and information connected with Geology, Mining, Metallurgy, through organizing technical lectures, discussion etc., by holding Seminars, Conferences, Technical Meeting and Tours, Publication of regular Journals, Transactions, Newsletters and Scientific Research work.*
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# President's Message

Dear Colleagues,

I am pleased to introduce this new special issue of *MGMI News* on the interface of health, safety and environment for mining and allied industries. The last two quarters have taught us how the industries and economy at large are strongly linked to public health. While the COVID-19 pandemic has been the short-term focus for several months now, we hope that this leads to a larger discussion of what long-term role the mining and metallurgical industries could play in sustaining positive health and environment outcomes for the people and the ecology.

The mining industry has been at the epicenter of evolving health challenges since its inception. The impacts to air and water qualities due to coal and metal mining are well-known in India and internationally. It is therefore important to develop strategies to counter these externalities. Corporate social responsibility of several supporting organizations of MGMI – both industrial and R&D – have led to a positive outlook for future development consistent with the UN Sustainable Development Goals.

For future emerging technologies, it is important to evaluate how they could impact these three pillars apart from the conventionally considered engineering efficiency. For instance, can we develop novel technologies that are able to reduce and ultimately eliminate mining accidents? What are some global solutions that could be used as motivation for improving the livelihoods of people? First and foremost, we need to develop indicators and metrics that enable a framework for assessment of these dimensions.

While the environmental impact assessment (EIA) has been a useful tool for the industry, social impact assessment also is being carried out concurrently over the globe. Moreover, recognizing the need for ensuring safety in mining activities, it is imperative to regularly upgrade the technical and professional competency of the mine operators and workers. It is heartening to note that the trend of number of serious and fatal accidents in mines in India is declining. However, the recurrence of accidents in mines remains a nightmare to safety and health officials. Our dream should be to completely eliminate accidents in mines.

Ultimately, the mining and metallurgical industries in India, represented in large numbers in MGMI, aspire for the welfare of the employees and the people of India at large. Therefore, MGMI welcomes more discussions in the cutting-edge areas in this field.

I compliment the Editorial Board for bringing out this new special issue rich with new technical information that will spur discussion in our 2200+ membership.

**Anil Kr. Jha**
President, MGMI

# From the desk of Editor-in-Chief

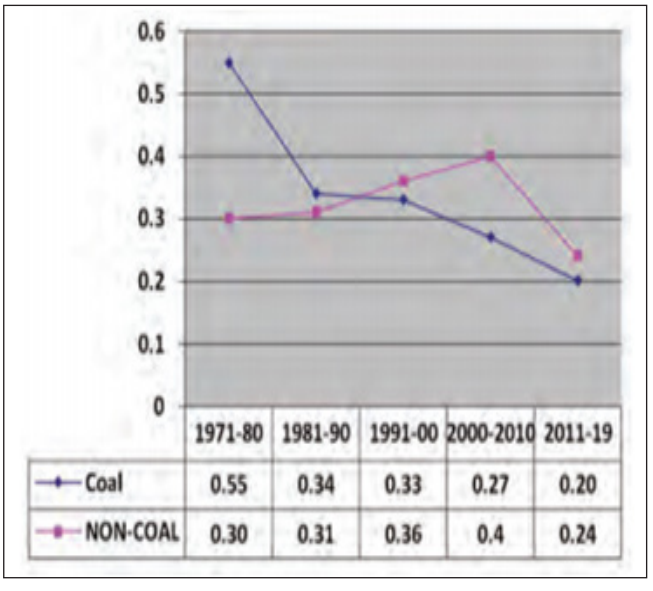
## Health, Safety and Environment, the keys for global competence of India in Mining.....

Global Mining Initiative's Mining, Minerals and Sustainable Development (MMSD) aims to promote corporate sustainability identifying the challenges and devising strategies towards a sustainable mining industry in future. Future mining industry aspires to be an environmentally sound, safe and healthy work place

Industrial work sites are often associated with sources of accidents, poor health and environmental damage. The price is being paid by the poor working people. The ILO estimates that some 2.3 million women and men around the world succumb to work-related accidents or diseases every year; this corresponds to over 6000 deaths every single day. Worldwide, there are around 340 million occupational accidents and 160 million victims of work-related illnesses annually. The ILO updates these estimates at intervals, and the updates indicate an increase of accidents and ill health. We need to come out of it through appropriate technology plans.

Occupational health and safety management of today's industry is fixing ambitious health and safety goals. This demands enhanced management skills, up-to-date legal awareness as well capability to adopt advanced technology to properly address health and safety issues. The industry also needs maintaining gender equality and principle of opportunities for all. Social licence to operate is one of the key issue in today's industrial ecosystem. Thus societal impacts of any industry on the community health, safety and environment are major decision areas along with the investment plans for the core business development in the mining and mineral sector.

In the International Labour Organisation (ILO) publications of work site fatalities, it is observed that there is a significant contribution from mining. There is no doubt that, mining is very important for the economy of many nations particularly for employment, direct and indirect revenues, investment and exports. Thus for the academics and researchers it is a challenge to develop appropriate technology for safe and environmentally friendly profitable mining. It is accepted by everyone that mining industries has many positive impacts, however, dangerous working conditions due to the geo-mining environment where mineral occurs, it is observed that often the situations push workers' health and safety at high risk. A larger section of the society, with reasons, argues that mining is a hazardous job and environment evil. It is quoted that according to ILO 1% of workforce is employed by mining worldwide and accounts for 8% of international work-related fatalities.




| | 1971-80 | 1981-90 | 1991-00 | 2000-2010 | 2011-19 |
|---|---|---|---|---|---|
| Coal | 0.55 | 0.34 | 0.33 | 0.27 | 0.20 |
| NON-COAL | 0.30 | 0.31 | 0.36 | 0.4 | 0.24 |

*Figure 1 Fatality frequency rate of the mining industry in Indian Coal and non-coal mining.*

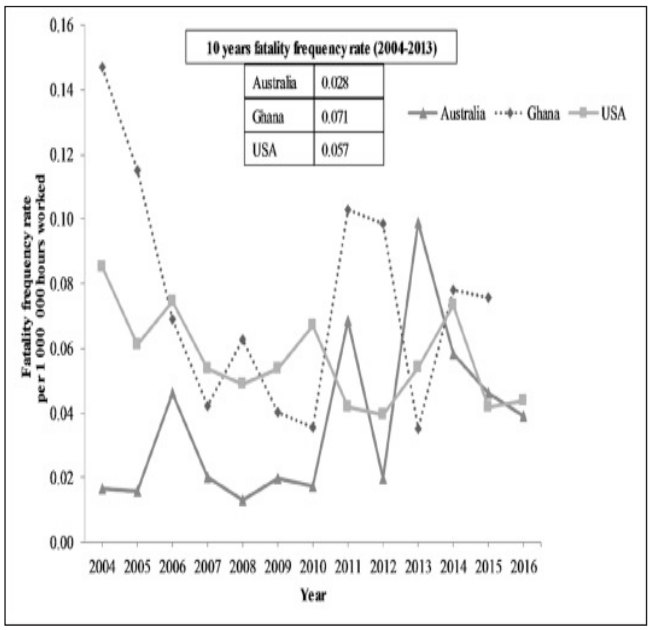



*Figure 2 Fatality frequency rate of the mining industry of Ghana, Australia, and the USA.*

The data of fatality in mining is shown in terms of fatality rates per 1000 persons employed in coal and non-coal mines on a ten yearly average basis. Though the trend in Indian coal mines show a steady decline as shown in Figure 1, it is much above the industrial fatality rate of other countries (Figure 2). The fatality in metal mining sector in India increased in the last decade, which demands a closer investigation. The trends in absolute numbers are shown in the following Figures 3. The graph shows Indian fatality rate is very high compared to Australia. However, in Australia, Safe Work Australia recognized that even the reduction in fatality rate is 12.4 in 2003 to 4.4 per 100,000 workers in 2015, this is still a very high per annum average fatality rate.

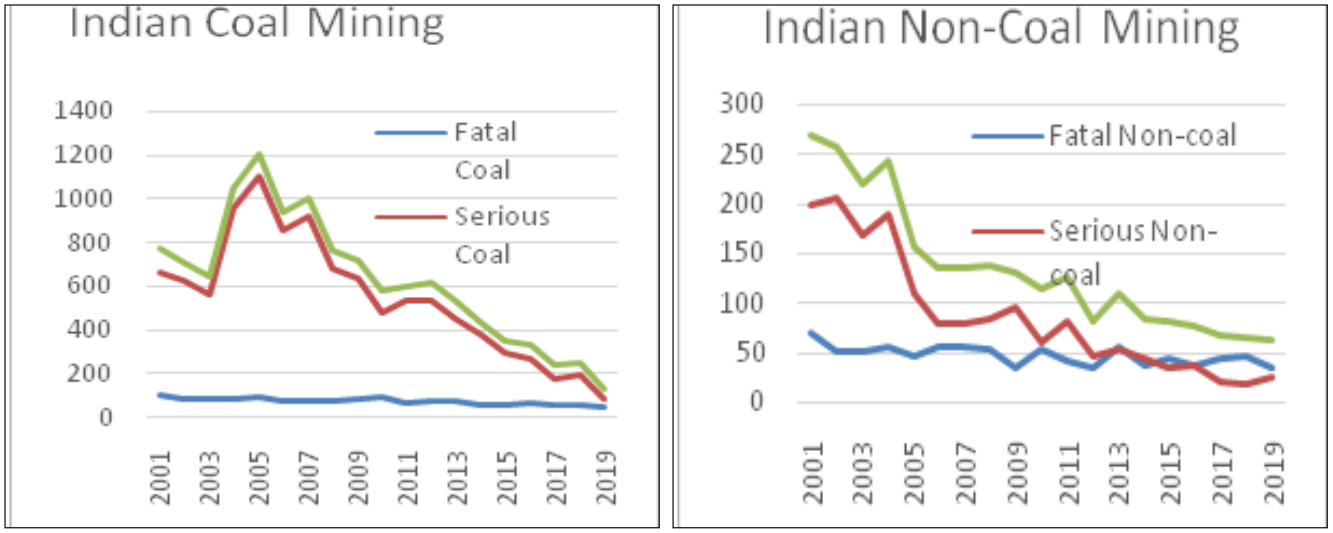



*Figure 3 The trend of accidents in mines from 2001 to 2019.*

The role of DGMS in achieving safety standards and goals in mining industry is very important. The higher rate of accidents or non-realization of zero fatality target depends to a large extent on the lack of our mine inspection and instrumented monitoring and warning system. In absence of indigenous development of monitoring instrumentation, the industry depends on imported instruments and expertize, which has many aspects requiring control to achieve the promised goals.

It is a good news that the present Govt has considered the need for **Strengthening of Systems & Infrastructure of DGMS (SSID)** initiated a pragmatic scheme with well defined objectives. The future is in technology. It is true that properly managed, technology can help create new, decent mining jobs. Automation is helping promote the integration of women in mining, reduce risk and raise productivity. For enhancing safety, in Indian mines our mine regulators must open new areas of automation and remote controlled mining.

We need to find pit top office of underground mining machinery operators with his hand on joysticks and eyes on the monitor screens (Figure 4). Alternatively, sitting on his armchair in his air-conditioned operating cabin, may be located near the shaft bottom, he can operate the machine in a hot humid surrounding at a kilometre away.

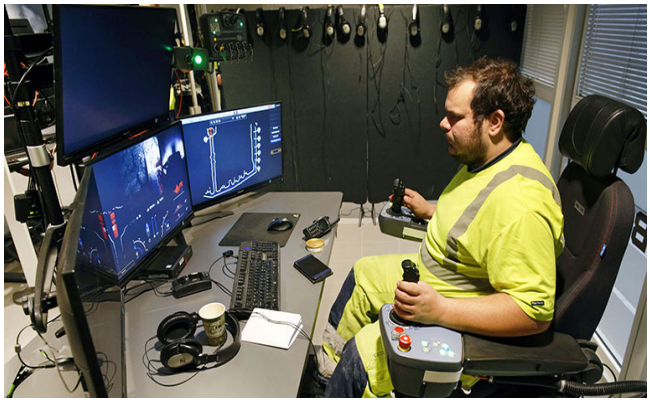


*Figure 4 At Boliden mine in Garpenberg, some 200 km northwest of Stockholm, Sweden (https://www.ilo.org/global/about-the-ilo/newsroom/ilo-in-the-media/lang--en/index.htm)*

Mining companies today must work hard to improve environmental performance and management of the mining industry through harmonization of environmental standards. The demand of today is efforts for developing new approaches for cooperation, knowledge sharing and technology transfer for propagation of best practices amongst the countries which produce mining products. For these, the academics, the researchers, the regulators, the government, the society and the industries must define their new roles that are to collaged to build the big picture of tomorrow's societal aspirations.

The MGMI also need to adopt new work culture to bring out national program like the Towards Sustainable Mining (TSM) that is now recognized as the Mining Association of Canada's (MAC) commitment to responsible mining. Similar to that India also needs to adopt a set of tools and indicators to drive performance and ensure that key mining risks related to health, safety and environment are managed responsibly at the facilities of our corporate member, Coal India Limited.

**Dr Khanindra Pathak**
Prof. IIT, Kharagpur
Editor, MGMI

The next issue of MGMI News Journal will be on :

**Commercial Coal Mining in India and Asset Management in the Mining and Mineral Industry.**

Authors are requested to contribute technical notes and papers on:

1. Recent changes in mining policies
2. Pros and Cons of Commercial Coal Mining in India
3. Challenges of mining asset management
4. Data as critical assets for planning and re-planning of mining facilities.

# Associate Editor's Column

*Illustrating the intersections of health, safety and environment in the coalbed methane industry*

We are bringing out this special issue at a time when the intersections between health, safety and the environment could not be clearer. The COVID-19 pandemic has created unprecedented stressors on public health and what safe practices entail, while also bringing about some positive environmental changes (albeit short-term). In the interest of the wider community, the mining industry constantly needs to envision the frontiers on these three pillars. In this column, this is illustrated via the example of the coalbed methane (CBM) industry.

Underground mining in India has been challenging since the beginning. Even before the independence, there were 13 major accidents caused due to firedamp (methane) explosion, resulting in over 500 casualties. While the rate of such incidents has gone down, the last major methane explosion in Bhatdih occurred in September 2006. Concurrently, the share of underground coal mining has also reduced, which has placed hindrances on the national coal production targets.

In the 1980s, a solution to the above issue was suggested in the form of methane drainage from coal mines to produce power. While these projects initiated in North America were envisioned to solve occupational safety hazards, a major co-benefit emerged. Within 5 years of commercial operations (1990-95) in the United States, the methane emissions from coal mining activities went down by 14% (Rychlicki S and Twardowski K, *PGISP*, 2002, 7, 215-224). Similarly, in China, about half of the overall emissions are being drained and in-turn, three-quarters of it are being utilized. The environmental benefits thus created are significant as the global warming potential of methane is 28-84 times that of $CO_2$.

Lately, though, the health considerations as arising out of CBM operations have also been talked about. A major health issue that may become significant as a large number of wells come online is that local soils and ecosystems may become affected due to brackish produced waters. These waters are rich in sodium and bicarbonate content as evident from our studies (Singh U et al, *Energy Sources*, 2018, 40, 1897-1909). Unmitigated handling may therefore cause detrimental effects towards crop growth and hydrology. At the same time, the CBM producing regions in India are accompanied by dramatically high water stress. Therefore, industries are looking to utilize these brackish waters by desalination and it is projected that the health benefits that could emerge would outweigh the treatment costs 4:1 (Singh U and Colosi LM, *Energies*, 2020, 13, 154).

The above paragraphs show how the CBM industry could make meaningful advances towards the three pillars of health, safety and environment. But how are these transitions possible? CBM production has gone up through the past decade but sufficient work needs to be done. As Mr. Jonathan Kelafant has pointed out in his interview in this issue of *MGMI News Journal*, release of CBM from price controls unlike conventional oil and gas is a positive regulatory step from the Government of India. This needs to be supplemented through technological upgradation for carrying out CBM operations in complex basins.

The permeability of Indian coal seams has been shown to be lower than the North American

counterparts. Accordingly, drilling and fracturing strategies would need to be reworked. Moreover, the presence of ancillary infrastructure would vastly facilitate an accelerated production of CBM. The manner in which CBM is extracted, whether through virgin blocks or as pre-mining drainage (in what is called as coal mine methane) and their subsequent processing would also determine the economic lucrativeness. Finally, the production may also be enhanced through injection of the several hundred million tonnes of $CO_2$ produced in regions adjoining these basins is also anticipated to enhance the CBM recovery process, while also providing additional environmental benefits.

Ultimately, timely production of CCS would not only help India's energy security but also lead to easier decarbonization opportunity. An integrated analysis of India's energy options shows that availability of gas options would constitute a large part of India's 2/1.5°C transitions (Vishwanathan and Garg, *Climatic Change*, in press). Faster action on CBM operations would also create a considerable infrastructural base for future exploitation of shale gas resources in the Damodar valley.

***Ajay K. Singh***
Former Scientist and Head,
Methane Emission and
Degasification
CSIR-Central Institute of Mining
and Fuel Research
Email: ajay.cimfr@gmail.com

**Scheme for Strengthening of Systems & Infrastructure of DGMS (SSID)**

(i) "Strengthening of Core Functions of DGMS (SOCFOD)", and (ii) Mine Accident Analysis and Modernization of Information Database (MAMID)". The objectives of the scheme are:

- To implement e-Governance in DGMS including digitization of plans, abandoned mine plans and other important documents;
- To implement Risk-based Inspection System for coal and non-coal mines;
- To render scientific and technical supports to the field officers of DGMS;
- To develop and maintain infrastructures of all kinds for DGMS and its backup supports;
- To develop, improve and update need based rescue and emergency response guidelines to the mining industry;
- To mitigate risk of disasters and accidents in mines through detailed analysis of accidents and dangerous occurrences and accordingly activate promotional channels;
- To disseminate mine information through various reports, technical instructions/ guidelines, circulars on electronic as well as other conventional media;
- To conduct need based Safety and Occupational Health Survey in mines;
- To introduce, implement and support the ebased examinations systems including digital record management system;
- To update training facilities in DGMS for imparting structured training to DGMS officers and key personnel of mining industry;
- To develop, improve and update protocols, guidelines and standards in key areas for guidance of operations in mines;
- To implement "Swachhta Abhiyan" within DGMS.

# Headquarters Activities

The Report of the 885th Council Meeting of MGMI held at MGMI Bldg., GN-38/4, Sector – V, Saltlake, Kolkata – 700091 on 28th December, 2019 at 12.00 noon (Duly approved in the 884th Council Meeting held on 19th October 2019).

PRESENT: Shri Anil Kumar Jha, President in the Chair. The meeting was attended by Prof Banerjee S P, S/Shri Jha N C , Ritolia R P, Saha R K, Goenka J P, Talapatra Ranajit, Karmakar Anil Kumar, Roy Prasanta, Bose L K, Chakrabarti Smarajit, Prof Dasgupta Sajal, Dr Moitra AK, Nag T K, Dr Samantaray A K, Dr Sen Kalyan and Lochan Rajiw.

**ITEM No. 0 Opening of the Meeting**

**0.1** On request of the President the meeting commenced at the scheduled time. The Hony. Secretary requested Shri J P Goenka, Vice President, MGMI to Chair the Session to start the meeting. The Chairman extended welcome to Council Members present, Past Presidents present in the meeting. Thereafter, he requested Hony. Secretary to take up the Agenda items.
Meeting started as per the Agenda Items for discussion and decision.

**0.1.1** Leave of absence were granted to those who could not attend the meeting.

**885.1.0 To confirm the Minutes of the 884th Meeting of the Council held at MGMI Building. Kolkata – 700091 on 19th October, 2019 at 11.30 a.m.**

The draft Minutes were circulated to all the Council Members. So far, no comments were received. The Council resolved that the Minutes of the **884th** (4th meeting of the 113th Session) Meeting of the Council, held on October 19, 2019 at MGMI (H.Q). Kolkata be confirmed..

**885.1.1 To consider matters arising out of the Minutes.**

The Council considered the Action Taken Report in respect of the Minutes of the 884th Council Meeting held on 19th October, 2019 at Kolkata and noted the report.

Further, Hony. Secretary informed to the Council that the 61st Holland Memorial Lecture was organised by Delhi Chapter at Delhi and as approved by MGMI, expenditure involved for the event was shared by HQ the 50% of total expense i.e. is Rs. 2,17,497/- and balance by Delhi Chapter.

**885.2.0 To report about the 8th Asian Mining Congress and Exhibition held on 06-09, November 2019.**

The report of the 8th Asian Mining Congress and IME 2019 together with Recommendations of the Congress (8th AMC 2019) were circulated to all the Council members along with the Notice of the present 885th Council meeting and also additionally placed on the table. The Council advised that the Report and Recommendations be printed in MGMI News Journal for information to the members. It will also be placed on the MGMI Website.

Income and Expenditure details of the 8th AMC and IME 2019 was briefed to the Council and approved with note of appreciation to the Organizing Committee Members to set new milestone of success and surplus fund generation for MGMI.

**885.3.0 To elect office bearers viz Vice-Presidents, Hony Jt Secretary, Hony Treasurer and Hony Editor for the year 2019-20 amongst Council Members of the Institute.**

**Vice Presidents:** The following members have

been elected unanimously as **Vice Presidents** for the year 2019-20

Shri Binay Dayal, Director (Technical), CIL - newly elected
Shri P K Sinha, CMD, NCL - re-elected
Shri P R Mandal, Former Advisor, MOC – re-elected
Shri J P Goenka, Mg. Partner, Nanda Millar Co. – re-elected

The following Members have been re-elected unanimously for the year 2019-20 as:

**Hony. Jt. Secretary** : Shri Ranajit Talapatra
**Hony. Treasurer** : Shri Anil Kumar Karmakar
**Hony Editor** : Prof (Dr) Khanindra Pathak

**885.4.0 To consider applications for membership and the membership position of the Institute.**

a) The Council approved 05 Life Membership Applications.
b) The Council noted the present position of membership as follows:

**Membership Position**
(As on 28.12.2019)

| | 19.10.2019 | Add | Trans | Loss | 28.12.2019 |
|---|---|---|---|---|---|
| | | | | | |
| Member | 265 | - | - | - | 265 |
| Life Member | 2538 | 05 | - | - | 2543 |
| Associate | 40 | - | - | - | 40 |
| Student Associate | 06 | - | - | - | 06 |
| Life Subscriber | 32 | - | - | - | 32 |
| Subscriber | 01 | - | - | - | 01 |
| Donor | 03 | - | - | - | 03 |
| Patron | 04 | - | - | - | 04 |
| Corporate | 08 | - | - | - | 08 |
| Life Corporate | 00 | 02 | - | - | 02 |
| | 2897 | 07 | | | 2904 |

The Hony. Secretary informed to the Members that Coal India Ltd and CMPDI are opted to become Life Corporate Member of MGMI and CIL paid the requisite fee also.

**Membership Drive** : While discussing on Membership, it has been felt that there are very little growth in Membership. To strengthen the Membership a Committee has been formed with the following Council Members for special drive of membership growth:

Prof. (Dr) Sajal Dasgupta, Dr A K Moitra, Dr A K Samantaray, and Shri Anil Kumar Karmakar.

**885.5.0 Future Programmes (i) Foundation Day Lecture, (ii) President's Cup Golf Tournament, (iii) Short Term Course etc.**

**Foundation Day Lecture :** It was discussed and proposed that 17th Foundation Day Lecture would be held in Asansol (ECL, Dishergarh Auditorium, the place where 1st Foundation Day Lecture was held), sometimes in 4th week of January 2020. It was also proposed that Prof S P Banerjee, Past President, MGMI and Former Director, IIT, (ISM, Dhanbad) to be formally requested to deliver the lecture.

**President's Cup Golf Tournament:** A Committee has been constituted with the following Members to organise President's Cup Golf Tournament (2020):
Shri J P Goenka - Convenor
Shri V K Arora – Co-convenor
Shri Anil Kr Karmakar – Co - convenor

The Venue has been proposed at Sambalpur, MCL Golf Ground with Budget of Rs. 3.5 lakhs which will be arranged through Sponsorship. The tournament date will be decided by the Committee.

**Short Term Course:** Hony. Secretary happily informed that the **2nd Short Term Course cum Workshop on Global Environment and Greenhouse Gases from Energy Systems: Estimation and Mitigation (GEM 2020)** will be again jointly organised by MGMI and CSIR-CIMFR during January 20-25, 2020. Hony. Secretary requested Shri Prasanta Roy, Coordinator to further elaborate on Short Term Course in details. Shri Roy informed about Programme, Course fee, Sponsorship fee, Accommodation, Industrial Visit etc. Council appreciated the efforts and wishes all success.

In the meantime, the President arrived and joined in the meeting. The Hony. Secretary, summarised the proceedings to the President.

Arising out of the discussion on Short Term Course, it was proposed that in future a Short Term Course should be organised on **Exploration Techniques** which is one of the most important topics of the day.

It was also proposed and discussed that each subsidiary of Coal India Ltd. may be approached for organising a Short Term Course inclusive of field visit on **"Sustainability Development in Mining considering Environmental Issues" and "New Legislation – CMR2017"**. In this connection, a Committee has been constituted with the following Members to draw course plan:

Prof S P Banerjee
Shri Nirmal Chandra Jha
Dr Amalendu Sinha
Dr Ajay Kumar Singh

President requested Prof S P Banerjee and other members of the Committee to prepare a **white paper** on the subject and on receipt of the same, he would appropriately propose to all CMDs of the subsidiaries of CIL for consideration.

**885.6.0 Any other matter with the permission of the Chair.**

Shri R K Saha, Past President, MGMI informed that Mrs. Tanusri Dutta, Sr. Librarian would be retiring on and from 1st January 2020 and he requested for re-engagement on contract basis atleast one year considering her appreciable contribution to MGMI. On detailed discussion the Council agreed the proposal and it was decided that she would be engaged on contract basis for one year on a lump sum amount considering the last salary drawn.

**Calcutta Chapter :** Dr A K Moitra , Chairman, Calcutta Chapter invited all Members to attend Get-Together which is going to organize by MGMI Calcutta Chapter on 19th January 2020 (Sunday) at NIRALA RESORT, DEOLTI, HOWRAH to celebrate its 28th Annual Get-Together, contribution being Rs. 400/- per head..

The meeting ended with Vote of thanks to the Chair at 2.00 PM.

# Report & Recommendations of the Award Criteria Committee Online Meeting held on 10th July, 2020

**PRESENT:** Prof S P Banerjee, Prof B B Dhar, Shri N C Jha, Dr Kalyan Sen, Dr Amalendu Sinha, Prof Khanindra Pathak, Prof Bhabesh Chandra Sarkar, Prof N C Dey, Shri Rajiw Lochan, Honorary Secretary, Ex-officio Member. Shri A K Jha, President, MGMI has very kindly attended the meeting.

**ITEM No. 0 Opening of the Meeting**
Shri Rajiw Lochan, Hony Secretary extended welcome to all the respected members to the online meeting of the Award Criteria Committee and thanked them for sparing their valuable time to be online to attend the meeting. Thereafter, he requested Shri A K Jha to Chair the Session to start the meeting.

0.1.1 President extended welcome to Members present in the meeting and requested Prof SP Banerjee to shower his blessings to all members present in the Meeting.

Prof Banerjee thanked and wished that everybody should stay safe and in good health.

Hony Secretary requested Prof SP Banerjee to deliberate on the **Guidelines for MGMI Awards of Excellence.**

**0.1 Discuss and finalise the Draft Guidelines for MGMI Awards of Excellence.**

A draft copy of the **Guidelines for MGMI Awards of Excellence** was circulated to all members over email before the meeting. Each and every point was meticulously discussed in detail and all members expressed their views for all the points to finalise the **Guidelines.**
The final "**Guidelines for MGMI Awards of Excellence"** as agreed upon and accepted by the Committee is given in **Annexure I**, which will be effective from next year.

President, Shri AK Jha thanked Prof SP Banerjee for taking the time to analyse every minute detail and deliberating and finalising the **Guidelines for MGMI Awards of Excellence** which was a very important requirement/task to be accomplished and decision to be taken for fixing the norms of Awards.

Hony Secretary requested Shri NC Jha to conclude the session.

Shri NC Jha concluded the Meeting with thanks to the Chair and each member for expressing their open views and sharing their valuable suggestions/comments in order to give a final shape to the **Guidelines for MGMI Awards of Excellence** which was a long pending agenda/ task and ended the meeting at 9:00pm.

"Let your unique awesomeness and positive energy inspire confidence in others."

# Report of the 2nd Editorial Committee Online Meeting held on August 23, 2020

Metting was attended by Prof Dr Khanindra Pathak, Dr Ajay Kr Singh, Shri Smarajit Chakrabarti, Shri Ranjit Datta, Prof Rajib Dey and Shri Rajiw Lochan.

**ITEM No. 0 Opening of the Meeting**

**0.1** Shri Rajiw Lochan, Hony Secretary extended welcome to the members to the second online meeting of Editorial Board 2020-21, and thanked them for sparing their valuable time to be online to attend the meeting. Thereafter, he requested Hony. Editor, Prof (Dr) Khanindra Pathak to take up the proceedings.

**0.1.1** Leave of absence was granted to those who could not attend the meeting.

**0.1.1.1** Prof (Dr) Khanindra Pathak, Editor-in-Chief, took up the agenda items one-by-one for discussion and decision.

**MGMI Transactions Vol 116, April 2019 - March 2020**

Prof (Dr) Khanindra Pathak, Hony Editor, raised the concern that due to the lack of standard technical papers the publication of MGMI Transactions is getting delayed. In the last paper meet held on June 14, 2020, out of four papers received, only three were standard papers that can be published.He also added that Memorial Lectures if any may be included in Transactions as well.

Shri Smarajit Chakrabarti suggested that it would be a good idea to include biographies or excerpts of general interests from several places along with the papers.

In connection with MGMI Transactions, Prof (Dr) Pathak also referred to the guidelines to be prepared for awarding the best technical paper for MGMI Transactions as suggested by the Award Criteria Committee and approved by the Council as well.

Shri Rajiw Lochan, Hony Secretary suggested that the awards criteria should be set in such a way that it attracts authors to submit standard technical papers and to achieve that level/standard, MGMI Transactions should be accredited by renowned publishers. In this context, he also cited the example of Coal India Ltd who have adopted a similar strategy and started a point grading system. If, MGMI can adopt such asystem, it will be highly beneficial as more people will be attracted to become member of MGMI and would be eager to submit more standard papers.

Prof Rajib Dey seconded Shri Rajiw Lochan's suggestion and informed that even Universities are adopting similar strategies and criteria for promotion of faculty based on this concept and many of their papers have been published in UGC accredited Journal/s.

Prof (Dr) Pathak and Dr Singh both were of the same view that accreditation can only be obtained if MGMI can submit the best relevant papers from previous MGMI Transactions or from previous Asian Mining Congresses and publish a special book. In this connection, Hony Secretary, suggested that Shri Ranjit Datta, who is considered 'encyclopaedia of MGMI', can help us a lot in this regard to sort out the best papers from last 15 years or so, to which Shri Datta has kindly agreed to extend his helping hands as always. Shri Chakrabarti suggested sorting out of the papers on a specific topic like "Alternative uses of Coal other than Power Generation" or alike. Prof (Dr) Pathak also added here to get standard papers/study reports from the industry and if published in a book form it can bring up the image of MGMI in International platform as an Institution.

It was finally decided that MGMI Transactions would be published with the papers received till date and yet to be received on next paper meet,

along with the Memorial Lectures available and if needed, some papers from previous Transactions as well. A Special Volume from MGMI could be published with a collection of best papers, preferably the award winning ones from previous MGMI Transactions and relevant papers/study reports from Industry. An attempt should be made to get it published by a renowned publisher under the supervision of Dr Ajay Kr Singh.

**2.0 Paper Meet**

Dr Singh, mentioned that till date four standard papers have been received from last paper meet and there is a research paper entitled "Geotechnical Assessment of Vindhyan Sandstone of Kaimur Group, Son Valley" submitted by Videshi Chaudhary, a PhD scholar of BHU which has not yet been presented and may be considered for which another paper meet may be conducted if the board agrees. In this context, he also added, that he can approach some good authors and try to get few more standard papers for publication in Transactions. Hony Secretary suggested that at least two papers should be available for conducting the paper meet efficiently. In this connection, Prof (Dr) Pathak requested Hony Secretary to try and get some papers from CMPDI, if possible. It was decided that the next paper meet to be organised when at least two papers would be available and Hony Secretary would try to get some standard papers from CMPDI, preferably from Blasting Cell, if possible, and schedule the date of the paper meet on receipt of the papers.

**3.0 MGMI News Journal - Vol 46 - No 2 - July - September 2020 Issue**

Prof (Dr) Pathak informed that the last day of submission of papers for MGMI News Journal - Vol 46 - No 2 - July - September 2020 Issue is 25$^{th}$September, 2020 and all the members should request their references to submit the papers latest by 15$^{th}$ September, 2020 so that it is easy for the printer to compile and generate the pdf version for uploading in MGMI Website.

Dr Ajay Kr Singh raised the query regarding the theme of MGMI News Journal, July - September 2020 issue. Prof Rajib Dey suggested that the theme may be- "Waste Utilization of Steel Plant". Dr Singh also pointed out that we have received a bioskectch of Shri Krishnanunni, Former Director General, GSI which can be considered for publishing in MGMI News Journal.

After discussions, it was unanimously decided that the theme would be **"Health, Safety and Environment in Mining & Allied Industries"** as already mentioned in the previous (April – June) issue and editorial board members will approach relevant organisations like DGMS, CMPDI and others and try to get good and standard papers. MGMI Office to work actively on the proof checking part to ensure an error free version.

Meeting concluded at 6.00 p.m. with thanks to the Chair and Hony Secretary for nicely arranging and conducting the virtual meeting through e-platform.

**Do you know Agate?**

Agate, common semiprecious silica mineral, a variety of chalcedony that occurs in bands of varying colour and transparency. Agate is essentially quartz, and its physical properties are in general those of that mineral.

# New Members

***(As approved in Council Meeting held through Video Conference using Google Meet on August 16, 2020)***

**As Life Member**

**10830-LM** Shri Kamal Ghosh, BSc(Hons) Min,Director (Retired),41, New South Park, aghajatin P.O. Regent Estate, Kolkata – 700092,Ph: 8910954523, E-mail: ghoshji@rediffmail.com

**10831-LM** Shri Ashish Kumar Samantray, M.Tech(Min) BE (Min)DGM (Mining) OMC Ltd. C/o. Somanath Samantray, At/P.O. BADAGADA, Samantray Sahi, Bhubaneswar – 751018, Odisha Ph: 9937297144, E-mail: ashish_samantray@yahoo.com

**10832-LM** Shri Mallikarjun Sarapur, BE (Min),DGM(Min), OMC Ltd.S/o. A. S. Sarapur, OMC Colony H No. –UC – 2, Near St. Merry School Barbil,Dt. Keonjhar, Odisha-758035,Ph: 8763673728/9938100639
E-mail: mallikurjunsarapur@gmail.com mallikarjun@odishamining.in

**10833-LM** Dr. Ismail Mondal, Ph D (Remote Swnsing & GIS),Assistant Professor, Jadavpur University School of Oceanographic Studies,Jadavpur University, West Bengal,Kolkata – 700032,Ph: 9836952240 E-mail: ismailmondal58@gmail.com

**10834-LM** Dr. Shobhana Dey,PhD (Mineral Processing) M Tech, MSc (Chemistry) Senior Principal Scientist,CSIR-National Metallurgical Laboratory,Jamshedpur, M.N.P Division,Jamshedpur – 831007 Ph: 9471117866/9470525100,E-mail: sd@nmlindia.org

**10835-LM** Shri Abanikanta Pradhan, Degree(Min) Exami IEI,DGM (Min), OMC Ltd.Regional Manager, Koira, OMC Ltd, At & P.O. Koira,Dist. Sundargarh - 770048Ph: 06625-235301 (O)/9437431943 E-mail: abani.omc@gmail.com

**10836-LM** Shri Pankaj Kumar Satija,PGDBM,MEE, B.Tech(Mineral),Chief Regulatory Affairs,
Tata Steel Ltd, House No. 22, Sector 14A, Vasundhara,Gaziabad – 201017, UP,Ph: 8092084533/9304216563 E-mail: pk.satija@gmail.com

**10837-LM** Shri Birendra Kumar Jain, Doctor of Enggg., MS, MSc(Geo Sci),Dy. GM(Retd.), ONGC A – 136, Sector – 27, Noida, UP – 201301,Ph: 9312266571,E-mail: bkjain12@hotmail.com

**10838-LM** Shri Desraj Gupta, FCC(Coal),E- 40, G/F, G.K. III, Masjid Moth,New Delhi -110048 Ph: 49876484/9811320057,E-mail: kusum.desraj@gmail.com

**10839-LM** Shri Ghanasyam Sahoo, Degree(Min) (Sections A&B) Exami EAI,Addl. General Mnager (Min) OMC Ltd, Bangur Mines,Dist. Keonjhar, Odisha – 758078,Ph: 9861768472 /
E-mail: Ghana_rashmita@yahoo.co.in

**10840-LM** Shri Shailendra Kumar Tamotia,BE(Hons) ME (Civil) Hon. Dean cum Director General & Vice Chairman,Bhavan's Centre for Communication & Management, Bhubaneswar,Flat No. D – 801, Gymkhana Palm Heights Near Sum Hospital, Shampur, P.O. Ghatikia, Bhubaneswar – 751003,Odisha,Ph: 0674-2535727/0674-2386789, Mobile: 9937011356, E-mail: sk_tamotia@yahoo.co.in

**10841-LM** Shri Ramesh Kumar Marwaha, B(Tech)Min, GM (Retired) CMPDI,Flat No. G-51 Ground Floor, South City – 2, Gurgaon,Haryana – 122018,Ph: 0124-2211165, 9310555744

**10843-LM** Shri Chinmay Kumar Parida, B Tech PGDM,Sr. Manager (Min), OMC Ltd,At Borijhola, P.O. Rayagada,Dist. Rayagada – 765001, Odisa,

Ph: 9742158721 / 8073298717
E-mail: omc.chinmayparida@gmail.com

**10844-LM** Shri Laxmikanta Prusty, M Tech (Mineral) BE (Mech),General Manager (Project),The OMC Ltd., Bhubaneswar, Qr.No. C-1, OMC Colony Unit No. B, P.O. Mayapalli, Bhubaneswar, Dist. Khorda, Odisha – 751012 Ph: 9937178848, lkp.omc@gmail.com

**10845-LM** Dr. C K Baiju, M Sc(Geol) M Phil PhD,Director,Directorate of Mining & Geology (Kerala) P.O. Pattam Palace,KesevaDasapuram,,Tri vahdrum– 695004,Ph: M -9447047429 / 9447117785 E-mail: baijudmg@gmail.com

**10846-LM** Dr. S. Vediappan, M Sc(Geol) PhD,Deputy Director,Department of Geology & Mining Govt. of Tamil Nadu,503/1, SakthiIllam, Central Jail Backside,MDS Nagar – 5th Cross, Hasthmpatty,Salem – 636007, Tamil Nadu ,Ph: 9443695071,E-mail: geovedi@rediffmail.com

**10847-LM** Shri SVS S Ramalingeswarudu, B(Tech) Min, M(Tech) (Min),General Manager (HRD) The Singareni Collieries Company Limited,Qr. No. NA -2, Near Trimatha Temple,Writer Basthi, Kothagudem, Bhadradri,Dist. Kothagudem Telangana -507101,Ph: 9491144105/ srldu1960@gmail.com

**10848-LM** Prof. Sahendra Singh, B Sc(Geol) M Sc Tech (Appl Geol,) PhD (Economy Geol),Associate Professor, Department of Applied Geology,Associate Dean ( Faculty – Selection & Career Progression) Indian Institute of Technology (ISM),Dhanbad – 826004, Jharkhand,Ph: (0326) 2235723/2235215 Mobile: 9471191375,E-mail: sahendra@iitism.ac.in

**10849-LM** Shri Prasoon Kumar Sinha, BSc Engg (Mech),Associate Vice Presedent (Mine Planning) 504, Amravati Apartment,Circular Road, Ranchi – 834001,Jharkhand,Ph: 9431596656
E-mail: prasoon_sinha2000@yahoo.co.in

**As Associate**

**10842-A** Ms. Rajyashree Nandy, MSc (Appl Geol.) Staff Consultant (Hydrogeology)SRK Mining Services (India) Pvt. Ltd, 17/1, Station Road, Sandhya Abasan, Flat – B, Floor – 2, VIII-Nalta, ,P.O. Dum Dum Cantonment, Kolkata – 700028, WB, Ph: 8274088317 /8777545967, Mobile: 7679301108,E-mail: rnandy@srk.co.in

**NEWS ABOUT MEMBERS**

**As on 1.7.2020**

Shri Pulak Baran Chakraborty (10629-LM) MMGI, PARAMAITA, Jamuna 1, Vastu Vihar Porject, Hari Bazar, Durgapur, PO Fuljhore, Paschim Bardhaman, WB 713 206 E-mail: pulakbaran@gmail.com

Shri S K Jha, MMGI Binayak Enclave, Block O, Flat 401, 59 KC Ghosh Road, Kolkata (Near Sinthi More) Pin 700050, WB E-mail: jhashibakant@gmail.com

Dr Girendra Mohan Prasad (6511-LM) MMGI is now Chief Scientist, Mine Mechanization & Technology Development (MMATD) Research Group, Room No. 12, Ground Floor, Main Building, CSIR-CIMFR, Barwa Road Campus, Barwa Road, Dhanbad 826 015, Jharkhand eE-mail: prasadgm@yahoo.com, (M) 9430149978

Shri Jeetendra Kumar (10596-LM) MMGI is now Area Finance Manager, MCL Basundhara Area, At/PO Tiklipara, Dist. Sundaergarh, Odisha 770076 eE-mail: jeetu541@gmail.com

Shri Malay Tikader (10688-LM) MMGI is now Dy DG, Room no 704, CGO Tower, DGMS, South Central Zone, Kavadiguda, Secunderabad 500080 eE-mail: malaytikader@gmail.com

Shri R T Mandekar (8999-LM) MMGI is now Director of Mines Safety, CGO Complex, Block A, 6th Floor, Seminary Hills, Nagpur 440 006 eE-mail: rtmandekar@yahoo.co.in
Shri Sunil Kumar Ghosh (4393-LM) MMGI is now at C-903, Koyla Vihar Vasundhara, VIP

Road, Kolkara 700 052 Ph: 9474122413 eE-mail: pathiknit12@gmail.com

Shri Janardan Prasad Pal, (6500-LM) MMGI is now at Flat no 502, G Heights, Gajanandpuram, Opposite to Hotel Trinity Grande, Kotra By-pass Road, Raigarh, Chhatisgarh 496 001 (M) 9109178566, 9425275329 eE-mail: jppal@ntpc.co.in Shri Jaswinder Pal Singh (8258-LM) MMGI is now at 601, Amrtas Mangal Smriti Appartments, 145 Pandey Layout Khamla, Nagpur 440 025 Ph: 6372982382 e-E-mail:jaswinderpalsingh rattan@gmail.com

Shri Sumesh Kumar (8433-LM) MMGI is now at Additional Chief Manager, Qr No 14-A, Type III, Block 20, Post-Neyveli-607803, Dist Cuddalore, Tamilnadu , (M) 9360566684, 9488996355, E-mail: sumeshkumar@nlcindia.in

Shri A K Sharma (8238-LM) MMGI is now Ex GM Civil MCL, Sambalpur Orissa, KM 29/1403 JP Kosmos Sector 134 Noida 201304 email aksgvr@rediffmail.com Ph: 8002335841

BEML BAGS RS.842 CRORES ORDER FROM MINISTRY OF DEFENCE BEML, the leading Defence equipment manufacturer, has bagged a prestigious order from Ministry of Defence for supply of 330 High Mobility Vehicles, for Pinaka Project at a value of Rs. 842 Crores. Pinaka is a multi-barrel rocket launcher developed indigenously for the Indian Armyand produced in India by involving Public Sector and Private Sector Defence Industries. The multi-barrel launcher system is mounted onthe highly rugged BEML truck,much acclaimed for its off-road mobility andwould provide the Indian Army with vital manoeuvrability on the battlefield. This order is a big boost to BEML, involved in the manufacturing of the High Mobility Vehicles with superior features under Make in India program, thus demonstrating BEML's efforts under 'AtmaNirobhar Bharat'. The equipment will be manufactured by BEML at its Palakkad Plant in Kerala and would supply the vehicle platform to MoD in a span of 3 years.

# News Update

## International News
## World's Largest Diamond Mine is Closing...

Argyle mine, located about 2,600 kilometers (1,600 miles) northeast of the state capital Perth, in the remote East Kimberley region of Western Australia produces virtually the entire world's supply of rare pink diamonds and will cease production at the end of 2020.

The world's biggest diamond mine—famed more for the coveted pink and red gems it yields each year than being a major producer of lower-quality stones—is being shuttered by the Rio Tinto Group that was operating the mine for almost four decades.


*Source: https://www.dalesjewelers.com/blog/2020/09/08/rio-tinto-reveals-six-heroes-from-the-2020-argyle-pink-diamonds-tender/*

**Blockchain technology used by Vale for sale of iron ore**

Vale has recently completed its first sale of iron ore using blockchain technology with Nanjing Iron & Steel Group International Trade Co. Ltd., a subsidiary of Nanjing Iron and Steel Co., Ltd (NISCO) for a cargo of 176 000 t of Brazilian Blend Fines (BRBF) from TelukRubiah Maritime Terminal in Malaysia to China. This transaction is aligned with Vale's strategy of becoming a more innovative and customer-centred company through greater integration with clients and partnering for the development of new solutions. It is an important milestone towards the digitalisation of the sales and trade process, bringing innovation to the traditional paper-intensive trade transactions and offering a better service to the clients as well as predictability in the steel value chain.

The Letter of Credit was issued through Contour blockchain platform whilst the shipping documents and the electronic Bill of Lading were handled via essDOCS' CargoDocs solution – with all actions carried out through a single, interfaced platform consolidated in Contour. The transaction also had the support from DBS Bank Ltd and Standard Chartered Bank Malaysia Berhad.

The integrated transaction enabled end-to-end security and transparency with real time visibility of the documentation to all stakeholders, drastically reducing the amount of emails and paperwork exchanged among the parties and providing enhanced user experience through access to a single solution to execute the trade.

(Source: Global Mining Review, Friday, 04 September 2020 16:15)

**Canada Nickel launches wholly-owned subsidiary to develop zero-carbon production of metals**

Canada Nickel Co. Inc. has recently announced that it has created a wholly-owned subsidiary, NetZero Metals, to begin the research and development of a processing facility that would be located in Timmins, Ontario, Canada, with the

goal of utilising existing technologies to produce zero-carbon nickel, cobalt and iron products.The electric vehicle industry and many other consumer sectors needs zero-carbon metal this decade.

As a result of the unique advantages of the Timmins region with its close proximity to zero-carbon hydroelectricity and our Crawford Nickel-Cobalt Sulfide project, comprised largely of serpentine rock that naturally absorbs carbon dioxide ($CO_2$) when exposed to air, Canada Nickel has the potential to develop zero-carbon products that the customers are expecting from the mining sector. With nickel as a preferred metal to power the clean energy revolution, the company is coming up with the commitment to net zero-carbon production. This isa right step to take for the environment, for consumers and for the investors of the company

(Source: Global Mining Review, Friday, 31 July 2020 09:00)

**European Commission recognizes Bauxite as 'Critical Raw Materials'**

The European Commission has reportedly included bauxite in the list of Critical Raw Materials for 2020 and shared an action plan and a foresight study on it for strategic technologies and sectors from the 2030 and 2050 perspectives.

The inclusion of bauxite in the European Commission's Critical Raw Materials list signifies the role of the aluminium industry in supporting Europe's transition to a green and digital economy.

NMDC, theIndia's largest commercial iron ore

Manual amethyst mine in the Ajanta region, India.
See: https://youtu.be/SxinBeNCIcw

**Amethyst is a purple variety of quartz (SiO2) and owes its violet color to irradiation, impurities of iron and in some cases other transition metals, and the presence of other trace elements, which result in complex crystal lattice substitutions**

# National News

## NMDC Looking forward to bright days

Producer and others are set to benefit from a surge in global seaborne iron ore prices. The rally in iron ore prices stems primarily from the supply crunch in Brazil, which is still coping with the spike in Covid-19 cases and will calm the frayed nerves of iron ore miners in India at a time when domestic demand has gone downhill.

International iron ore prices are now trending over $100 per tonne, clocking a year-on-year (YoY) gain of 10 per cent. The revival of Chinese steel production has bolstered demand for the key steel making ingredient. Simultaneously, disruptions in Brazil after soaring Covid cases has crimped supplies, raising prices.

Brazil is the world's second largest iron ore exporter. But its exacerbating Covid-19 crisis with a count of over 600,000 cases has triggered worries on supplies. Top Brazilian producer Vale has pruned its 2020 iron ore production guidance from 340-355 million tonnes (mt) to 310-330 mt. The rapid spread of Coronavirus cases in Brazil and rising infections among workers had precipitated fears of mining activity getting curtailed even though mining has been categorised as 'essential service'.

But China, the originator of the virus, has seen a swift rebound in its steel output. Demand for iron ore in China is expected to stay robust as the country would see a strong recovery in steel production. The recovery in China spells favourably for exporters as China makes half of the world's steel and has a whopping share of 70 per cent in global seaborne trade. At major ports in China, iron ore inventories are tapering. Iron ore prices are currently trading at a 52-week high on the Dalian Commodity Exchange in China.

(Source: Business Standard June 6, 2020)

**Indian Coal Mining: Mega Investment Plan**

54 mining projects of Coal India are facing delays. This delay is mainly due to the delays in obtaining forest clearance and issues related to rehabilitation and resettlement. To meet the goal of producing 1Bte of caol by 2023-2024, Coal India limited has planned 123 coal projects costing Rs 20 crore and above are in different stages of implementation. Out of these 69 projects are on schedule and 54 projects are delayed as per news update of Sep 09, 2020, in ToI. During 2019-20 coal India limited sanctioned18 mining projects with a total rated capacity of 132.04 million tonnes per annum and a total investment of Rs 21,244.55 crores were approved by the board of CIL and its arms. The company sanctioned nine non-mining projects alsowith a sanctioned capital of Rs 855.52 crore. during 2019-20, Coal India Limited commissionedthree mining projects, with a sanctioned capacity of 9.60 million tonnes per year that had capital investment of Rs 1,052.57 crore. It was envisaged that the state-owned coal mining company will pump in over Rs 1.22 lakh crore on projects related to coal evacuation, exploration and clean coal technologies by FY24, to achieve 1 billion tonnes of fuel output target. Out of these proposed spend of over Rs 1.22 lakh crore, Rs 32,696 crore is planned to be invested in coal evacuation, Rs 25,117 crore in mine infrastructure and Rs 29,461 crore in project development by 2023-24.

**Manganese Mining News**

Manganese Ore India Limited (MOIL) working on new projects worth Rs 581 crore at mines in MP, Maharashtra. The company is working on multiple new projects worth cumulatively Rs 581 crore at its mines in Madhya Pradesh and Maharashtra, according to its annual report. The company is aiming to complete these projects


by August 2021, the miner said in its Annual Report 2019-20. At Munsar mine in Maharashtra, the company is setting up a new vertical shaft at a depth of 160 metres at a capital cost of Rs 51.32 crore.

**Indian Bauxite mining wants export friendly policy**

India's mining industry has urged the government to re-examine an export duty of 15% imposed on bauxite that has sharply cut down shipments as well as policy measures to facilitate production of the aluminium-making material.

R.L. Mohanty, vice president of Federation of Indian Mineral Industries told a conference titled "Leveraging Indian Bauxite and Aluminium Industry for Atmanirbhar Bharat (Self-Reliant India)" on Friday that the country's export of the aluminium-making resource had shrunk to a meagre 0.5 million tons during 2019-20 from a peak of 8.9 million tons in 2015-16.

India has the world's sixth-largest reserves of bauxite and can utilise the resource for economic development when several other sectors are under stress due to the pandemic, industry executives said.

"Export of bauxite leads to generating direct and indirect employment and the socio-economic development of local communities, stevedores and other related ancillary industry," Mohanty said.

India is one of the leading players in aluminium industry with the second aluminium capacity and third-largest production in the world. Still, the country ends up importing 60% of its aluminium needs that results in an outgo of $5.5 billion annually.

Aluminium is one of the most widely used metals with its application ranging from construction, aircraft and car bodies to cables.

"Rising imports of aluminium needs to be restricted in order to promote domestic production to realise the country's vision for a self-reliant India," Mohanty said.

India's primary aluminium capacity stands at 4.1 million metric tons per annum and downstream processing capacity at 3.9 million tons. However, the domestic aluminium consumption is expected to reach 10 million metric tons by 2031-32.

To meet the future demand, India needs to increase its bauxite production from 23 million tons to around 70 million tons by 2032, Mohanty said.

(Source: column written by BimanMukherji, consulting editor at Indoasiancommodities.com.)

**Indian Copper Mining**

As per ToI news a parliamentary panel has asked state-owned Hindustan Copper Ltd (HCL), involved in mining or beneficiation, smelting, refining and casting of refined copper metal into dowstreamproduction, to look at measures to remove hindrances for timely execution of expansion projects and optimally utilise the plan outlay.

The committee notes that during 2019-20, out

of the Rs 402 crore allocated for its expansion projects, HCL could utilise Rs 103.43 crore up to December 2019... The committee hopes that HCL would take timely steps to remove all the bottlenecks for timely execution of expansion projects and would optimally utilise their plan outlay of Rs 600 crore during the year 2020-21. The development of second phase of Khetri mine

could not be commenced due to non-finalisation of tender owing to high price quoted by the single bidder. Same was the case with the tender related to Chapri-Siddheswar mine.

The committee feel that all these projects are instrumental for exploration and exploitation of copper in the country and hence, the mines ministry should give serious consideration to remove these procedural delays for timely execution of projects.

Like every year Coal Miners Day 2020 was also was observed on 4th May amidst the lock downs due to COVID 19.

*Coal mining is recognized as one of the toughest profession and to highlight the way the coal miners work in coal mines Coal Miners Day is observed every year on May 4. The country should create more awareness for this program to recognize the contributions of coal miners to the Nation building.*

# Interview

## Trends in Unconventional Gases

– Mr Jonathan R. Kelafant*

**Unconventional gases, including coalbed methane and shale gas have drastically altered the energy markets in the last two decades. They are also associated with critical issues surrounding fugitive methane leakage, water contamination and large water footprint. Our Associate Editor, Dr. Ajay Kumar Singh caught up on these trends with one of the leading global experts on unconventional gases, Mr. Jonathan R.Kelafant, Senior Vice President, Advanced Resources International, Inc, USA. He has over 30 of years of experience in natural gas resource recovery and assessment in over 20 countries including Australia, Botswana, China, Colombia, Czech Republic, Germany, India, Kazakhstan, Mexico, Mozambique, Poland, South Africa, Turkey, Ukraine and Zimbabwe. He manages domestic and international energy projects with a primary emphasis on the technical assessment and development of gas resources.**

***Tell us a bit about yourself. How did you end up at Advanced Resources International?***

That's a long story! When I finished graduate school, getting my masters in geology, I went to work for a firm called Lewin & Associates as a geologist. I worked there for about a year and then a large company, ICF Inc., purchased us. After a few years, my group within ICF decided to leave the company and we had a management buyout and formed Advanced Resources International in 1991.

***What type of work does your organization do, and how is that critical in the energy industry?***

The three main areas of our current work are:

First, unconventional gas (including coalbed methane, shale gas, tight gas) where we work on engineering and geology aspects of the resources, plus reservoir modeling. We are also involved forecasting gas prices and gas market development, both domestically and internationally.

Second, carbon capture and sequestration. Again, we focus on the engineering and geologic aspects of projects. We have managed some of the largest CCUS demonstration projects, including the drilling and coring work and managing the field operations.

The last area of our work is support work for the US Environmental Protection Agency (EPA) and their greenhouse gas reporting program. All the industries in the US that emit $CO_2$, methane and other GHGs are required to report their emissions annually. When they send their reports, we verify that proper guidelines and algorithms have been followed and make sure that all the datasets are accurate.

***What do you think is the current outlook for the coalbed methane industry globally?***

I think it depends on the country. 10-15 years ago, there was a big global push and people were looking everywhere. Now, the United States and Canada are not developing any CBM projects. As far as countries where we are seeing activity, obviously India is very active. We also see a lot of interest in South Africa and Botswana, where there are several projects going on. There is also a bit of interest in Turkey. Australia has ongoing CBM projects, where the projects feed into the

* *Sr. Vice President, Advanced Resources International,Inc.USA, Email : JKelafant@adv-res.com*

liquefied natural gas projects. In China, there are still some operations, but not as many as there used to be.

***Most of our readers would be interested in understanding how could CBM be given a push in India. What are the technology and policy changes needed there?***

Lately, the Indian government has taken some positive steps to encourage CBM development. They released CBM from gas price controls, which is a great market-based incentive for projects. Also, the terms and conditions for the CBM bid roundsare not as stringent as they are for conventional oil and gas. These are two big changes in terms of policy and regulation. In terms of technology, I think there are some issues with the lack of oil and gas infrastructure and support services. Here in the US, one can call up a company and have a fracturing job done in a week or so. In India, there are a limited number of companies to perform hydraulic fracturing and other required field services. It is just a matter of amount of available equipment and technology. The operators obviously know how to do these operations there is just an uncertainty in who you can purchase it from.


*Mr. Kelafant has actively collaborated, with India's coal industries within and outside the Global Methane Initiative. Here, he is seen addressing a workshop organized at CMPDL in 2013*

***How has the trajectory of shale gas and CBM changed over the years?***

Certainly, the CBM trajectory has been downward while the shale gas trajectory has been upward. As I mentioned previously, CBM exploration and development in the U.S., Canada, and elsewhere has ceased almost entirely and most of the gas wells being drilled in N. America are shale gas wells. Shale wells have much higher productivity, although they are much expensive to drill and their decline rates are very steep.

***Please describe your role in helping shape the CBM technologies and policy in association with EPA and other agencies.***

We have worked with the US EPA for almost 25 years now. With EPA, their focus has been coal mine methane which is the capture of methane from coal mines to prevent it from being emitted to the atmosphere. Under the EPA program, we perform a range of tasks, from writing technical papers to producing pre-feasibility and feasibility studies for coal mines. For example, we have

performed three studies at different Indian mines. We also assist EPA in putting on workshops and seminars.

***How would you place ARI's outlook on geologic $CO_2$ sequestration?***

I personally do not work in this area, but many of my colleagues who do are very bullish on it. As I said, we have been involved in a number of CCUS demonstration here in the US. It will need some financial incentives to make it work. In the U.S., we created tax credits called the 45Q credits in which provides an incentive of \$30-50/t-$CO_2$, depending on whether it is used for enhanced oil recovery or stored in saline aquifers or other deep formations. The credit came out a couple of years ago, but the final details are still being ironed out. Once the 45Q rules are finalized, we will likely see a surge of activity in this area.

***In light of climate change, how do you think the fossil fuel industry in general could be responding?***

I think that one of the big responses is $CO_2$ sequestration like I mentioned. A lot of major oil companies are putting investments into research, test projects and pilots. This has been a big response for the fossil industry to mitigate a portion of their carbon from their operations.

***Do you think that the investments in unconventional gases might be at risk due to the financial shock of COVID-19?***

During the first couple of months there were many disruptions in the oil industry. But they have seemed to work safely under the circumstances. So, for the supply aspects of the industry (e.g., drilling and production), I do not foresee major issues. However, there has been significant demand destruction due to the pandemic. I believe that as demand picks back up later this year/ early next year that companies will be able to ramp up production safely to meet the demand.

***What is your advice to young professionals who are looking to start their careers in the industry right now?***

I think that for young geologists and engineers, it is important for them to take some business courses and have some exposure to the business world. As you move up in your career, you do a lot less geology and more management related tasks (e.g., preparing budgets and forecasts). So, one thing I tell college students is to take some business courses. A lot of geologists romanticize about being out in the field, but rarely are you able to do that if you want to advance your career.

***To read some of Mr. Kelafant's work pertaining to the coal mine methane prospects in India, the reader may refer to the following paper:***

Hummel, J. A., Ruiz, F. A., and Kelafant, J. R. (2018). Quantifying the benefits of coal mine methane recovery and use projects: Case study on the application of in-mine horizontal pre-drainage boreholes at gassy coal mines in India and the optimization of drainage system design using reservoir simulation. *Environmental Technology & Innovation*, *10*, 223-234.

**Q: What weapon can you make from the elements potassium, nickel and iron?**
**A: A KNiFe.**
**Q: Anyone know any jokes about sodium deposits?**
**A: Na**
**Q: Why shouldn't you let a geologist drive your car?**
**A: Because they get hammered and stoned.**
**Q: Why shouldn't you lend a geologist money?**
**A: They consider a million years ago to be Recent.**
**Q: Where do geologists like to relax?**
**A: In a rocking chair**

**source: http://www.jokes4us.com/miscellaneousjokes/schooljokes/geologyjokes.html**

# Technical Note

## Intersection in Health and Environment: A Commentary on Covid-19 and Implications on Energy Industry

Jayant Singh*

**Introduction**

The ongoing pandemic of COVID-19 has had an unprecedented impact on the global health, economy, and environment. The virus (SARS-CoV2), which causes COVID-19, belongs to the same family of ß Coronaviruses as SARS and MERS-CoV but has proven to be more infectious and deadly. After its first case was reported in December 2019 in China, it has spread to across 200 countries infecting more than 30 million people and has led to more than 0.95 million deaths. The steep rise in number of cases due to the high transmissibility of the virus over whelmed the medical infrastructure of even the most developed countries. It kept many patients devoid of any medical assistance and the death count rose even further. Therefore, many countries including India, implemented nationwide lockdowns to contain the spread of the virus and lower the stress on its medical infrastructure. In India the lockdown period lasted from 25th March to the end of July 2020. The lockdown meant for people to strictly stay at home to avoid further spread of the infection, but by extension it also meant shutting down of almost all economic activities

This commentary discusses some of the implications of the COVID-19 pandemic on the energy sector, and in turn on the environment. This follows from previous discussion in this outlet from Devotta (2020). Notably, we describe the trajectory of key air pollutants, changes in energy use and future policy making avenues.

**COVID-19 and Environment**

During the lockdown, the internet was flooded with articles carrying anecdotes of environment healing during the lockdown and the degree of damage human activities have done to the environment. The social media pictures were posted of rivers running clean, clearer skies and the wild life reclaiming its habitat sightings of wild animals in the urban area, all across the globe. Therefore, a number of studies have been conducted using the ground satellite sensors that monitor air and water quality, to better understand and quantify the abated pollution.

The Air Quality Index (AQI) is a cumulative measure of the air quality, which takes into account the atmospheric concentration of all major pollutants. During the lockdown period (25th March to 3rd May 2020), all cities across India showed major reductions in its AQI, as shown in Table 1. Furthermore, proportionate reductions were observed in the levels of primary pollutants as well. PM (10 and 2.5) and $NO_2$ levels reduced about 50-60% and 40-70% respectively over the period of lockdown with the corresponding period in 2017-2019, as shown in Figure 1 (Singh et al, 2020), whereas $SO_2$ and $O_3$ levels showed only minimal variation across the country.

Table 1: Pre and post lockdown values of AQI across different states in India (extracted from Lokhandwala and Gautam, 2020)

| State | AQI before lockdown | AQI during lockdown | | | |
|---|---|---|---|---|---|
| | 14th Jan | 24th March | 31st March | 7th April | 14th April |
| AP | 216 | 62 | 69 | 29 | 37 |
| Chandigarh | 75 | 35 | 38 | 41 | 45 |

* *Research Assistant, National Institute of Advanced Studies, IISc Campus, Bangalore*

| | | | | | |
|---|---|---|---|---|---|
| Delhi | 301 | 99 | 24 | 37 | 53 |
| Karnataka | 143 | 105 | 50 | 57 | 63 |
| Maharashtra | 122 | 94 | 68 | 55 | 67 |
| Punjab | 106 | 49 | 26 | 43 | 51 |
| Tamil Nadu | 172 | 42 | 40 | 29 | 27 |
| Telangana | 130 | 64 | 64 | 47 | 77 |

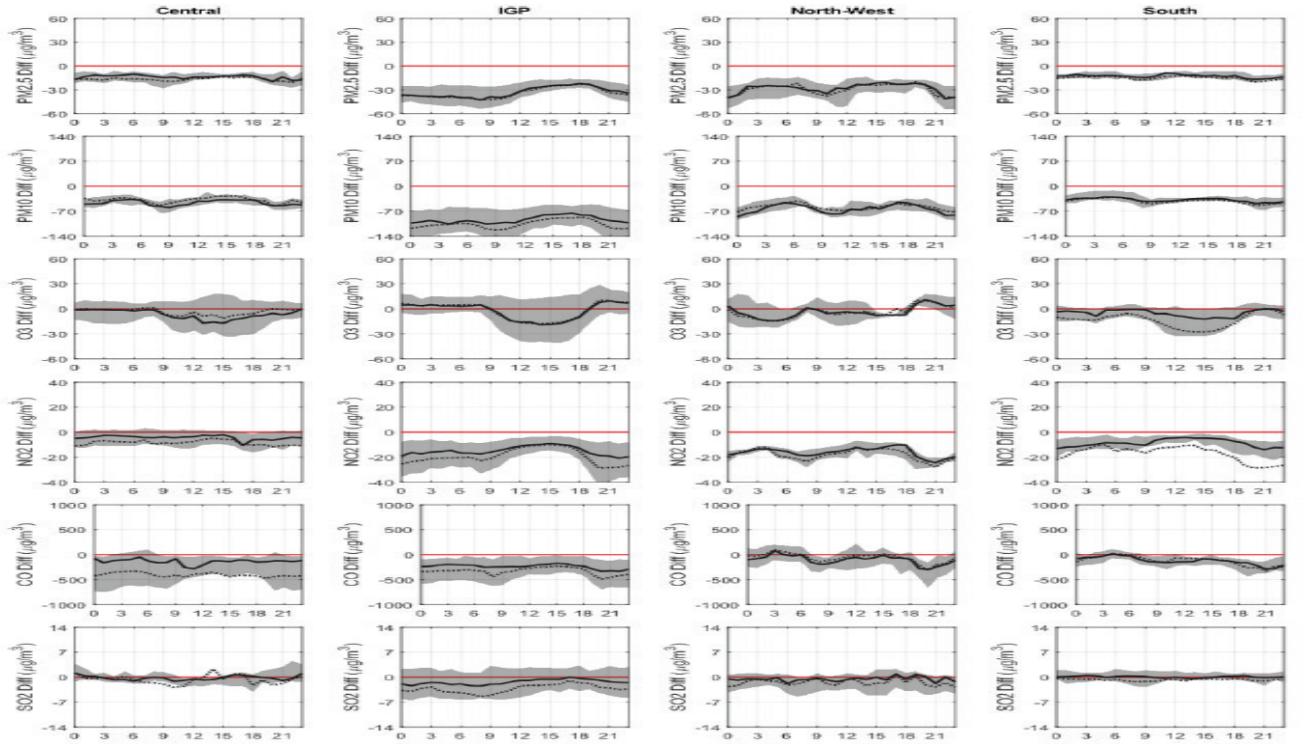



Figure 1: Concentration difference of PM2.5 and PM10 in the lockdown period compared to the corresponding period in 2017-19 (Singh et al, 2020)

Satellite observations of Aerosol Optical Depth (AOD) were in line with the ground observations made for particulate matter, since AOD has been proven to be an indicator of particulate matter pollution. As shown in Table 2 (Ranjan et al, 2020), AOD anomaly (as given by equation 1) for most states show a negative value indicating that particulate matter pollution has seen reductions during the lockdown period.

$$\text{Anomaly (\%)} = \frac{(x)-(\bar{x})}{(\bar{x})} \times 100 \qquad (1)$$

Where is the mean AOD in 2020 and is the average AOD from 2000-2019.

At the same time, the pandemic itself has been compounded by additional features. For instance, the $CO_2$ emissions from California have increased dramatically due to the wildfires.

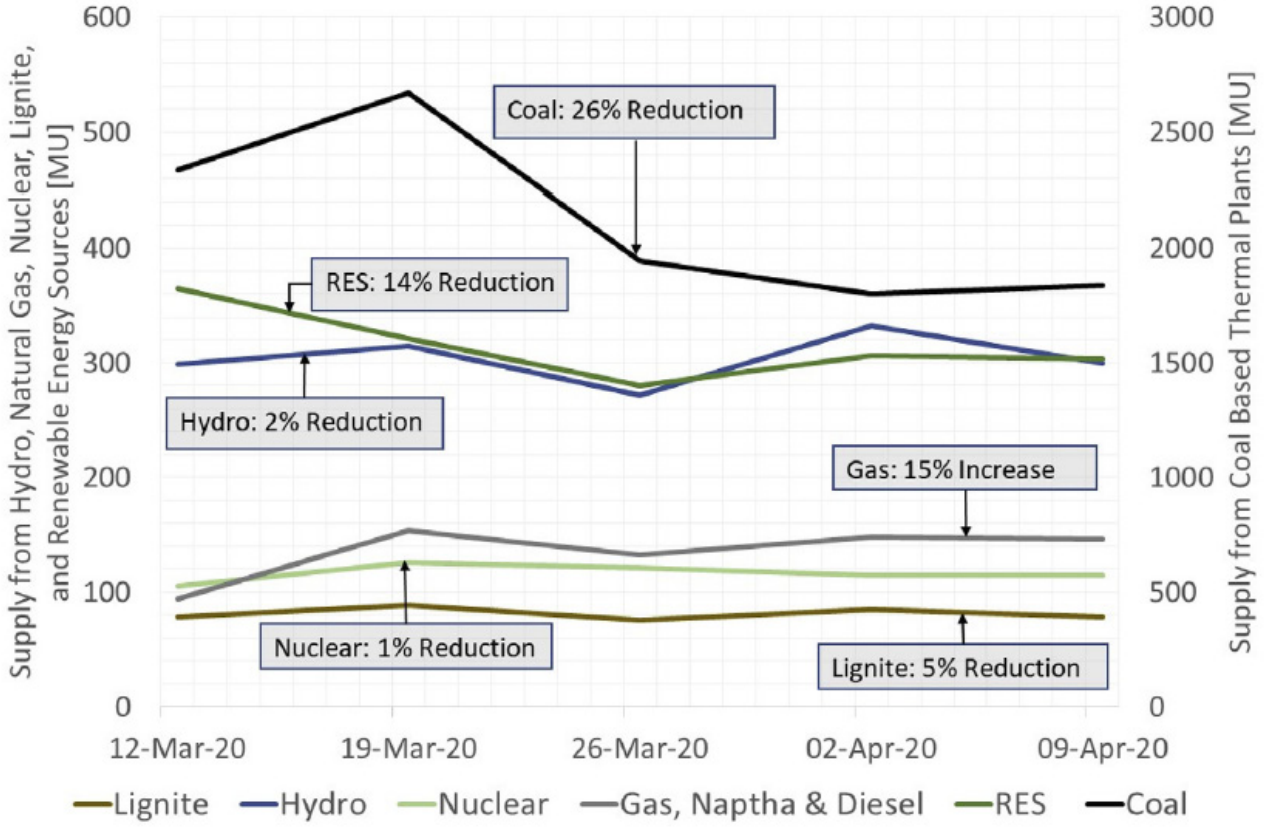



*Figure 2: Energy supply from different sources in the pre and during lockdown period (Kanitkar, 2020)*

Table 2: AOD anomaly for different states in India (Data from Ranjan et al, 2020).

| State | AN | AR | As | BR | CH | CG | DN | DD | DL | GA | GJ | HR | HP |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| A O D anomaly | 0.4 | -0.5 | 0.3 | -3.1 | -15.6 | 11.7 | 2.3 | -1.2 | -31.3 | -27.7 | -14.2 | -37.8 | -9.3 |
| State | JH | KA | KL | LD | MP | MH | MN | ML | MZ | NL | OD | PY | PB |
| A O D anomaly | -8.6 | -7.3 | -15.3 | 3.1 | -0.3 | 13.7 | -13.2 | -23.1 | -24.3 | -0.3 | 3.3 | -26.8 | -28.7 |
| State | RJ | SK | TN | TR | UP | UK | WB | AP | TS | LK | JK | | |
| A O D anomaly | -16.9 | -8.8 | -21.5 | -17.9 | -19.4 | -42.5 | 0.7 | -0.4 | 13.4 | -0.2 | -22.9 | | |

**COVID and the energy industry**

Lockdown has also significantly impacted the energy usage patterns within the country. The total energy demand dropped by around 20% during the lockdown period in comparison to pre lockdown period. Within the power sector, the supply from each energy source saw a decline except for gas, which was 15% rise as shown in Figure 2. Further, according to the Ministry of Petroleum and Natural Gas, Government of India, the consumption of road transport fuel dropped by around 50-60%, aviation fuel dropped around 90%, but domestic fuel increased by around 12% in reference to the corresponding period in 2019. The data also shows 40% and 70% reduction in industrial and construction activities. Reduced energy usage at this scale would not only mean reduced pollution but also $CO_2$ emissions which

was around -90 $MtCO_2$ by the end of April 2020. There were significant implications on the energy markets as well. For instance, for the first time, the price of dropped to below zero, indicating a rapid decline in demand. Several new investments in fossil fuels and renewables might affected but there is uncertainty as to the actual impact. Grid balancing has also become a real challenge in light of the changed patterns of electricity use.

**Future perspectives and recovery pathways**

As discussed in the review of a few research articles above, impacts of the COVID-19, though short-term have been seen on the energy sector and accordingly on the emissions as arising (Sharma et al, 2020). In terms of planning appropriate recovery pathways and government stimulus packages, it is important to be mindful of environmental goals. For instance, governments must invest in technologies that are capable of delivering longer-term mitigation and also improve reliability through grid storage. Furthermore, the public health challenges might amplify the pollution in the future with restrictions on public transport use (e.g. Delhi Metro). Ultimately, the transition must be strategically defined to enhance the role of low-carbon technologies.

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**Why did the miner only have three children?**

**He was told one out of every four children born in the world was Chinese.**

**********

**The Mine Manager went to one of his miners after an accident, the injured man said, 'my leg, arm, head really hurt when I touch them.'**
**The Manager started feeling the mans leg, arm and head, 'Does this hurt? or this? or this hurt?'**
**'No' the man said.**

**Manager: 'You fool! You've broken your fingers.'**

# Technical Note

## Occupational Hazards of Miners and Health Issues in Mining Areas

– Dr. Rupali Baruah*, – Dr Debarshi Paul**

**INTRODUCTION:**

Coal, or often referred to as *black diamond*, has been a part and parcel for the industrial sector as well as for household utility since ages. It is the most important and abundant fossil fuel in India. The quest of man for utilizing a better fuel has always been a priorityand this led him to the discovery of coal and its widespread use. With an increasing population, an economy that is growing amidst ups and downs and the pursuit for an improved quality of life, the demand of energy is escalating in India.

TheNorth Eastern regionof India, at present, has mines operating in the states of Assam, Meghalaya, Nagaland and Arunachal Pradesh. Assam is blessed to be a harbor of rich natural resources which includes oil and natural gas, coal, tea, medicinal plants and of course the famous silk of Assam. Although not every natural resource needs to be extracted through mining, coal is one which has to be mined and for which man power is essential. Like all good things come with a price, coal is no exception. Every year hundreds of miners fall ill due to various diseases related to mining. With the exception of accidents, the diseases related to mining are chronic and the suffering is long lasting.

The history of commercial coal mining in India spreads nearly 246 years, starting from 1774 by M/s Sumner and Heatley of East India Company in the Raniganj Coalfield. Due to lack of demand, advanced machinery, transportation and other factors, the growth of Indian coal mining remained stagnant for about a century. The introduction of steam locomotives in 1853, the World Wars I and II, emergence of new factories and industries etc. were a boost to coal industries again. Gradually the demand increased and so did the number of companies and mines. The first coal company of India was the Singareni Collieries Company Ltd. (SCCL) which came into existence in the year 1945. After Independence, the country commenced the 5-year development plans and the coal companies and thus coal mining began to flourish.

The geological formations in the North Eastern regionis spread over a vast area comprising of the Brahmaputra and Surma Valleys, southern flanks of Mikir Hills, the North Cachar Hills, the north foothills of the Naga-Patkai range, northern foothills of the Garo, Khasi and Jaintia Hills, north and south banks of Brahmaputra in Goalpara,Singimari area at the border of West Garo Hills. Out of the seven states of the North Eastern region, Assam has the second largest area. The Makum Coalfield in Assam is the largest coalfield of the North Eastern region.

The exploration stride, however, has been extremely slow due to inaccessible hilly terrain, thick forests, heavy rainfall, lack of infrastructural facilities and difficult formation for drilling. Coal was first quarried near Saffrai in1928. The Assam Railway and Trading Company (AR & TG) opened the first mine in Ledo in 1882. Subsequently, many collieries namely Tikak, Namdang, Ledo New West, Tirap, Ledo New East, Baragolai, Tipong and Namdang deep were taken over by Government at the time of nationalisation of coal mines.[1]

**FACTORS ASSOCIATED WITH OCCUPATIONAL HEALTH:**[2]

1. **Physical factors**: These are directly linked with the job environment. The related physical factors are the working conditions, working posture of the mine workers, vibration, effect of poisonous gases and physical injury.

* *Dr. RupaliBaruah, Professor and Head, Dept. of Community Medicine, Assam Medical College & Hospital, Dibrugarh (e-mail: rupali999@yahoo.com)*

** *Dr. Debarshi Paul, Senior Resident (Post PG Specialist), Dept. of Community Medicine, Assam Medical College & Hospital, Dibrugarh (e-mail: debarshipaul@gmail.com)*

2. **Personal factors**: Personal factors of the coal mine workers who work in shifts and have less interaction with their social surroundings are directly or indirectly linked with their social life and their habits. These factors may be addiction or mal adjustment between work place and family or social surrounding.

3. **Psychological factors**: The psychological factors of the occupational workers are their state of mind or their mental health which are frequently associated with stress and strain, mining related diseases (leading to a poor mental status mostly depression or irritability) and outcome of the profession (hazardous profession, like mining tend to grow a sense of insecureness for their life and their familiesleading to the psychological misbalance)

**OCCUPATIONAL DISEASES IN COAL INDUSTRIES:**

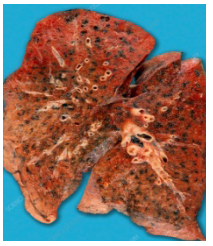
Mining environment and coal dust can cause a broad spectrum of diseases in the miners, the severity ranging from mild disease to severe debilitating illness and even death. A few of them are furnished below.

**1. Anthracosis andCoal Miners' Pneumoconiosis**: Also known as Black lung disease, it is caused by inhaling coal dust over a prolonged period (about 12 years or more). It can lead to fibrosis where lung tissue becomes thickened and stiff, loses elasticity, scarred and damagedwhich leads to greater risk of emphysema, chronic bronchitis and tuberculosis. Black lung accounts for more deaths than do mine accidents, including explosions and cave-ins. There are two types of Coal Miners' Pneumoconiosis (CMP) are:

*a)* *Simple Coal Miners' Pneumoconiosis*: A focal collection of coal dust particles with a little reticulum and collagen accumulation, visible as small opacities (usually less than 1 cm in diameter) on X-rays.

*b)* *Complicated Coal Miners' Pneumoconiosis*: Characterized by progressive massive fibrosis (PMF) i.e. lesions consisting of a mass of rubbery well defined black tissue that is often adherent to the chest wall. This is associated with decrease in ventilating capacity, low diffusion capacity, abnormalities of gas exchange, low arterial oxygen tension, pulmonary hypertension, and ultimately death.

Once the background of simple Pneumoconiosis has been attained in the coal worker, progressive massive fibrosis may develop out of it without further exposure from coal dust. Epidemiologically, the risk of death among coal miners has been nearly twice that of the general population. [(2)]Coal Miners' Pneumoconiosis has been declared as a notifiable disease in the Indian Mines Act of 1952 and also compensatable under the Workmen's Compensation (Amendment) Act of 1959.

| | |
|---|---|
|  | **Normal Lung** |
|  | **Coal Miners' Pneumoconiosis (CMP)** |
|  |  |
| **An Autopsy Specimen of Lungs with Anthracosis** | **X-Ray Picture of Progressive Massive Fibrosis in CMP** |

| | |
|---|---|
| *Source*: MEDIMAG-ESCIENCE PHOTO LIBRARY | *Source*: Remy-Jardin M, Degreef JM, Beuscart R, Voisin C, Remy J. Coal worker's pneumoconiosis CT assessment in exposed workers and correlation with radiographic findings. Radiology. 1990; 177(2)363-371. doi10.1148/radiology.177.2.2217770 |
|  | **Progressive Massive Fibrosis** **(Complicated Pneumoconiosis)** |
| *Source*: NIOSH Coal Workers' X-ray Surveillance Programme (CWXSP) | |

**2. Silicosis**: It is a pneumoconiosis that results from prolonged and repeated exposure to airborne crystallized silica which causes fine levels of silica dust to be deposited in the lungs. Those who work in mines, quarries, and foundries have long recognized silicosis. The lungs become inflammed, create lesions and then form nodules and fibroids. Often silicosis is difficult to diagnose at its onset as there are no visible symptoms for a considerable number of years. As silicosis advances, the symptoms in varying degrees of severity begin to occur such as shortness of breath, fever, chest pain, exhaustion and dry cough. More advanced forms show cyanosis of mucus membranes, asthma or other breathing difficulties, similar to advanced emphysema resulting in laboured breathing and an increased susceptibility to infection. The disease may also lead to more susceptibility to acquire tuberculosis. In 1990s, silicon dioxide was classified as a carcinogen, and as such, silica exposure is now linked to the development of lung cancer.

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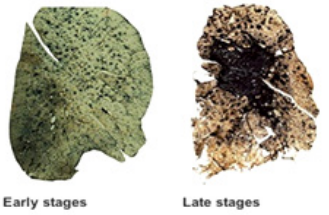
|---|---|
|  |   |
| **Autopsy Specimen of A Healthy Lung** | **Autopsy Specimens of Lungs with Silicosis** |
| *Source*: Silica dust: Regulations and controversy challenge construction industry/government relationships.Canadian Design and Construction Report | |

**3.Bronchitis**: It is a respiratory disease in which the mucous membrane in the lungs' bronchial passages becomes congested and inflammed. The irritated membrane swells and becomes thicker, narrows or shuts off the tiny airways in the lungs, resulting in coughs accompanied by thick phlegm and breathlessness. Caused by coal dust, it may be:

(a) Acute bronchitis: lasts for less than six weeks

(b) Chronic bronchitis: reoccurs frequently for two years or more.

**4. Stink Damp**: Also known as *Blackdamp* or *Stythe* or *Choke Damp*, it is a mixture of odorless poisonous gases and is formed when oxygen gets removed from an enclosed atmosphere (e.g. deep mines) and is largely replaced by carbon-dioxide, nitrogen, argonand water vapour. The available oxygen content reducesin this atmosphere to an asphyxiating level which is incapable of sustaining human or animal life. It is encountered in enclosed or poorly ventilated coal mines. The symptoms of Stink damp, especially in a physically strenuous job like coal mining, may be mistaken for dizziness, light-headedness, drowsiness and poor coordination, which are relatively less dangerous and can easily be ignored or misdiagnosed. But these may be due to severe oxygen deprivation. The time between the onset of initial symptoms and rapid unconsciousness can be as short as seconds. Thus, if a group of workers complain

of the same, it must be considered as a warning sign of Stink damp and immediately reported and attended to.

**5. Tuberculosis:** Tuberculosis or TB, is a common and deadly infectious disease caused by Mycobacteria mainly *Mycobacterium tuberculosis*. TB most commonly attacks lungs (Pulmonary TB) but can also affect the central nervous system, the lymphatic system, the circulatory system, the genitourinary system, bones, joints and even the skin. Mainly spread through respiratory droplets, it occurs frequently in places of overcrowding and poor living conditions. TB is completely treatable and the government provides free treatment via its nationwide vast programme the National Tuberculosis Elimination Programme (NTEP) through DOTS (Directly Observed Treatment Shortcourse).

Other medical conditions of miners related to their occupation may be:

**1. Anaemia**: It has been defined by WHO (World Health Organisation) as "a condition in which the hemoglobin content of blood is lower than normal as a result of a deficiency of one or more essential nutrients, regardless of the cause of such deficiency". There is a direct link between malnutrition in mine workers and anaemia.

**2. High BP:** Imbalanced diet with a considerable high amount of salt and lack of proper restmay be some of the many reasons of hypertension seen in many of the coal mine workers.

**3. Occupational Dermatitis:** The causes may be physical- heat, cold, moisture, friction, pressure, X-rays, and other rays; chemicals, biological living agents, such as viruses, bacteria, fungi plant products etc.Occupational dermatitis is largely preventable if the workers are given adequate protection against direct contact by protective clothing, long leather gloves, aprons and boots, soap and towels.

**4. Occupational Asthma:** The most common long-term and chronic disease of both adults and children is asthma. Mostly due to irritants, allergy or many a times familial, it is a chronic cause of morbidity in mine workers.The identification of occupational asthma in workers is important because early detection may lead to control of the worker's symptoms and control of the chemical in the workplace which caused the asthma. Pre-existing asthma may also be aggravated by workplace exposures.

**5. Eczema oratopic dermatitis**:It is a flare-up of the immune system in people's skin over when it reacts to environmental or emotional triggers and thus causes symptoms such as an itchy rash to appear. Some common causes of eczema flare-ups are changes in temperature or humidity or chemical irritants (pesticides, paint, alcohol, perfumes, harsh soaps, detergents and household cleaners, allergies to dust, pollen, mold etc).

**6. Migraine:** These are repetitive headaches separated by symptom-free intervals and accompanied by nausea and sensitivity to light. Generally migraine is the result of stress, sleep disturbance, hormonal fluctuations, and certain foods. Stress and sleep disturbance is often seen in mine workers. After a working shift when the workers come out of the dark underground and get exposed to bright outdoor light, it produces stress in the eyes causing migraine.

**7.Worm Infestations**: Especially Hookworm infestation, the symptoms of which are loss of appetite, weakness, feeling unwell and anemia due to occult blood loss. It mainly comes from working bare footed as hookworms enter the skin from contaminated soil.

Others may be physical weakness, dysentery, insomnia, sinusitis, tonsillitis, epistaxis (bleeding from nostrils),enteric fever (a form of food poisoning caused by bacteria named *salmonella typhi*), irritable bowel syndrome (IBS) and gastric ulcers,hyperhydrosis, syncope (temporary loss of consciousness) etc.

Good health is not only being physically fit, but also having a sound mind and social interaction. Stress related to work and work place can lead to

fatigue, impaired judgment and decision-making and is one of the principal causes of a significant degree of physical and mental ill health. Sickness absenteeism anddecreased productivity may be the direct or indirect results of stress.

The list of diseases is vast. Inhalation of coal mine dust is known to cause several types of respiratory diseases as described above. To emphasize that there is a spectrum, these have recently been termed "Coal Mine Dust Lung Disease" (CMDLD).[3]The various diseases encountered in the occupational field of coal miners may be categorized as below:

1. **Coal Mine Dust Lung Disease**: Chronic obstructive pulmonary disease (COPD), Coal-workers pneumoconiosis, Anthracosis, Silicosis, Asbestosis, Asthma and Respiratory conditions caused by toxic agents.
2. **Traumatic**: Carpal tunnel syndrome, Tendonitis, Accidents and Disorders associated with repeated trauma
3. **Miscellaneous**: Neurotoxic disorders, Noise-induced hearing loss, Dermatologic conditions, Psychological disorders, Severe occupational traumatic injuries, Reproductive disorders, Poisoning, Disorders caused by physical agents other than toxic agents, Malignant pleural neoplasm (e.g. Lung cancer), Occupational cardiovascular diseases, Lead toxicity, Pesticide and insecticide toxicity, Hepatitis A, B and C.

**TREATMENT OF CMDLD**

There is no specific curative treatment for CWP or other types of CMDLD.[4]

- Preferably, any further exposure should be restricted. Alternative means of support should be provided to avoid mining dust.
- Periodic evaluation of patients should be done to monitor progression and to provide symptomatic support. Complications such as airflow obstruction, respiratory tract infection, respiratory failure/ hypoxemia, corpulmonale, arrhythmias, and pneumothorax should immediately be treated or referred to higher centres.
- Significant crystalline silica exposure should raise the suspicion of complication by *Mycobacterial* infection (e.g. TB) and should be evaluated and treated accordingly.
- Miners should receive influenza and pneumococcal vaccinations as appropriate.
- Tobacco use should be enquired at every clinic visit and tobacco users should be counseled to quit and helped for the same.

**PREVENTION OF CMDLD**

There has not been a cure for CMDLD till now. Prevention is the best way to control it. National Institute for Occupational Safety and Health (NIOSH) has provided extensive recommendations for prevention.[4]

- The workplace is in fact the most important aspect of preventive measure rather thana clinician approach. NIOSH recommends limiting exposures to respirable coal mine dust to 1 mg/m3, and to respirable crystalline silica to 0.05 mg/m3, as time-weighted average concentrations for up to a 10-hour day during a 40-hour work week. Worker exposures should be kept as far below these recommended exposure limits as feasible through the use of engineering controls and work practices.
- Frequently monitoring worker exposures is also important so that interventions can be made if overexposures are detected. Use of a real-time personal respirable dust monitor in coal mines may be helpful.
- Medical screening and surveillance helps coal miners and also the screened population by detecting CMDLD early and thus interventions can be madeby finding out trouble spots in particular jobs or work place and also to prevent progression by limiting further exposure.

**NIOSH RECOMMENDS THE FOLLOWING PROGRAM OF MEDICAL SURVEILLANCE FOR COAL MINERS [5]**

- A spirometric examination and plain chest radiograph as soon as possible after beginning employment ("preplacement," within 3 months

for spirometric examination and within 3 to 6 months for chest radiograph).

- A spirometric examination each year for the first 3 years of coal mining and every 2 to 3 years after that if the miner remains engaged in coal mining.
- A chest radiograph every 4 to 5 years for the first 15 years of coal mining and every 3 years after that if the miner remains engaged in coal mining.
- A chest radiograph and spirometric examination at the end of employment in coal mining if more than 6 months have passed since the last examination.
- A standardized respiratory symptom questionnaire and a standardized occupational history questionnaire administered at the first examination and updated at each subsequent periodic examination.
- In addition to the above NIOSH recommendations, the World Health Organization recommends, "Ideally, health surveillance, particularly for workers exposed to silica dust, should be lifelong."

**CONCLUSION:**

Pre-placement examination, periodical examination, proper medical and health care services, prompt notification of notifiable occupational diseases, supervision of working environment, health education and counseling, control of dust, proper ventilation etc. can go a long way in early detection and prevention of occupational health hazards of mine workers. Also, social support and empathy of authorities towards workers can boost their mental health and make their lives less stressful.

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# Technical Note

## Safety Requirements for Electrical Installations at Petroleum Drilling Rig

A.K.Singh*, P.Bhukya**, R.K.Mishra*** M.K.Vishwakarma***,B.Modak**** and A.Kumar****

**Introduction**

Handling of oil and gas has always been a major concern for operation in oil fields. Liquid and gaseous hydrocarbons containing highly volatile substances have always caused major hazards in the past and keeps the people always alert to avert such hazards. The drilling of crude oil results in emission of hydrocarbons in the form of gases and vapours like ethylene, propane, etc. These gases coming out from the well mix with the air and form explosive zones.

The explosive areas are classified in three zones – viz. Zone 0, Zone 1 and Zone 2. Zone 0 is the area in which hazardous atmosphere is normally present continuously Zone-1 is the area in which hazardous atmosphere is likely to occur under normal operating conditions and Zone-2 is the area in which hazardous atmosphere is likely to occur only under abnormal operating conditions. Electrical motors, lighting fitting, control panel, junction boxes, starters, etc are some equipment, which are installed in these zones to make drilling rig (Figure-1) operational. These all items are having a type of protection against explosion known as flameproof or explosion proof. The Flameproof apparatus is an apparatus designed to sustain explosion pressure developed inside it due to any possible cause of ignition and to prevent transmission of flame from inside to outside area by quenching it between joints, which could ignite surrounding explosive atmosphere. Sometimes, increased safety motors are also used in zone 2 area. These motors are designed to be safe against excessive temperature rise of winding as well as are having non-sparking features with respect to voltage by maintaining adequate creepage distance, clearance and air gap.

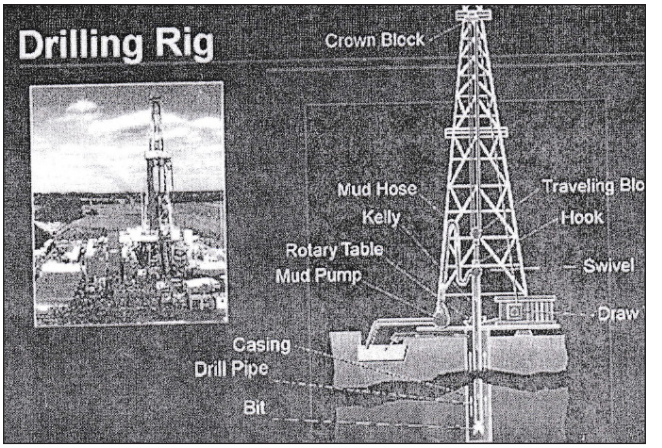


*Figure 1: Layout of Drilling Rig*

**Experimental**

A flameproof electrical apparatus is flameproof due to its mechanical structure. Material of construction, type of joint, length of joint, gap between two surfaces, size & shape of enclosure, nature of gas, etc., Strength of bolts, cementing materials for sealing boxes, cement for glass windows, sealing materials for interconnecting nipples are the parameters which make an apparatus flameproof.

**Flameproof Motor**

Starting from a fuel dispensing unit raving fuel pump of a few horse power to hydrogen recycling compressor having a compressor motor of hundreds of horse powers flameproof electric

* *Chief Scientist, Flameproof and Equipment Safety, CSIR-Central Institute of Mining and Fuel Research, Barwa Road, Dhanbad, Jharkhand-826001, India, cmri_arvind@yahoo.co.in*

* *Scientist, Flameproof and Equipment Safety, CSIR-Central Institute of Mining and Fuel Research, Barwa Road, Dhanbad, Jharkhand-826001, India, prasad207jntuk@gmail.com.*

** *Sr. Tech. Officer (1), Flameproof and Equipment Safety, CSIR-Central Institute of Mining and Fuel Research, Barwa Road, Dhanbad, Jharkhand-826001, India, rkm.cmri@gmail.com.*

*** *Technical Officer, Flameproof and Equipment Safety, CSIR-Central Institute of Mining and Fuel Research, Barwa Road, Dhanbad, Jharkhand-826001, India, bmodak@@cimfr.nic.in.*

motor in the basic driving force behind the application.

Flameproof motor is one of the basic electrical equipment used on a drilling rig. The applications of these motors are for mud mixing, mud agitator, shale shaker, fuel pump and hole filling, etc. All motors are of different capacity as per application but all should be flameproof or increased safety type for gas atmosphere encountered therein. The gas atmosphere formed by the hydrocarbons emitted from crude oil is classified under gas group IIB.

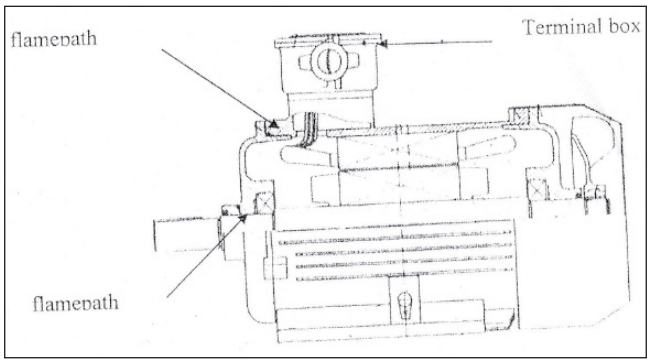


*Figure 2: Sketch of a flameproof motor*

A flameproof motor is stronger than a standard motor in terms of its pressure sustaining strength. The joints between end shield and the stator housing are normally spigotted joint maintaining min. 12.5mm flame path and max. 0.15mm gap. All the bolts between end shield & stator housing are having min. 240 $N/mm^2$ yield strength. Similarly the shaft and inside or outside bearing cover (floating gland) form a flameproof joint. The floating gland & end shield also forms flameproof joint. The terminal studs are effectively fixed into terminal base plate and form metal to non-metal joint. The terminal studs are effectively spaced from each other with adequate creepage distance & clearances, which make them non-sparking. The cover & terminal box body may either be having flange joint, spigot joint or threaded joint. In case of threaded join the length of direct axial length should be min. 8mm and min. 5 full threads should be engaged. The cable termination into terminal box is either through double compression cable gland or through sealing box. In case of sealing box the box should be filled completely with cement or cold setting sealing compound. For proper sealing a sealing box normally consists two holes – one for filling compound & other for releasing air to avoid formation of air bubbles. Figure-2 shows sketch diagram of a flameproof motor.

**Flameproof Lighting Fitting**

The drilling rig operates round the clock to extract crude oil from the earth. There is no night for drilling rig and to maintain day light in the area lighting fittings like well glass fitting. Tube light luminaries, flood light fittings are installed at all parts. These lighting fittings are flameproof and consist of toughened quality heat and impact resistant glass part. The glass is hold in a glass retaining ring and fixed with cement or epoxy potting compound having min. 10mm length covering three sides. The glass is always supported with a backing plate or ring from inside of the fitting. The flame paths & gaps or threaded path are always maintained between joints. The glass enclosure and the terminal enclosure are having interconnecting wire nipples or bushings to pass wires and are sealed with epoxy. Wire guard is provided to protect glass part from any mechanical impact. The max. meh size of wire guard permitted is 50 squares mm.

**Flameproof Control Panel/Junction Box**

To operate different electrical equipment control panels and junction boxes are placed at different places. The main purpose of a panel is to regularize the power supply to motors, lighting fittings, pumps etc. The junction box is used to distribute the power supply from one terminal to another terminal. The control panel or control gear boxes are having the provision to start/ stop power supply, indicate the ON/OFF status and to measure electrical parameters like voltage and current by providing voltmeter, ammeter. For flameproof construction the operating rods passing through the press fit bushes into cover maintain cylindrical joint and diametrical clearance as peer the gas group of application. The glass inspection windows are provided to

read the voltmeter, ammeter readings placed inside the panel.

**Tests for a Flameproof Apparatus**

The flameproof enclosure should pass a sequence of tests to be categorized as flameproof. These tests are reference explosion pressure tests, overpressure test & non-transmission of an internal ignition test. Also impact test, thermal shock test, maximum surface temperature (MST) classification, are the general requirement for all apparatus. Frictional non-incendivity of the material is also checked if the material of construction is light aluminium alloy.

**Before Reference Pressure Test**

**Test for a flameproof apparatus**

Design Evaluation and Physical Examination: A flameproof or explosion proof enclosure is strong enough to sustain explosion pressure developed inside and prevent the flame transmission from inside to outer explosive environment Flame path requirement between metal to metal and metal to non-metal should comply to IS/IEC 60079-1:2014. Non-metal to non-metal flame path is not permitted External connection to the apparatus should normally be indirect i.e through an integral terminal or non-integral terminal box cable entry devices like compression type of cable glands should be independently explosion proof she wall thickness should be adequate to withstand explosion pressure. Glass window and glass cover in the case of light fittings should be toughened and adequately sealed to the metal housing to prevent the flame to pass through.

**Ref Pressure Tests**

The tests consist of ignition an explosive inside the flameproof apparatus and measure the pressure developed due to explosion. The enclosure is tested with all the internal components. The development of pressure during the explosion and the pressure rise time are measured and recorded during each test. The highest of the maximum smoothened pressure obtained in these tests shall be taken as reference pressure. The test is repeated five times by changing the position of pressure gauge & spark plug & filling the fresh gas mixture Figure 3 shows the maximum explosion pressure recorded (6.3bar at 9.8ms) for a junction box for gas group I. As a result no deformation or damage should be observed on walls or cover of enclosure. Motors should be tested both in the running condition without load and in the stationery condition. The pressure should also be measured in the terminal box, where this does not constitute a separate enclosure. The enclosure shall be tested with all the internal apparatus. The hydrocarbons like ethylene, propane comes under gas group IIB. For this test the mixture of the test gas (8±1)% ($H_2$:$CH_4$::85:15) in air.

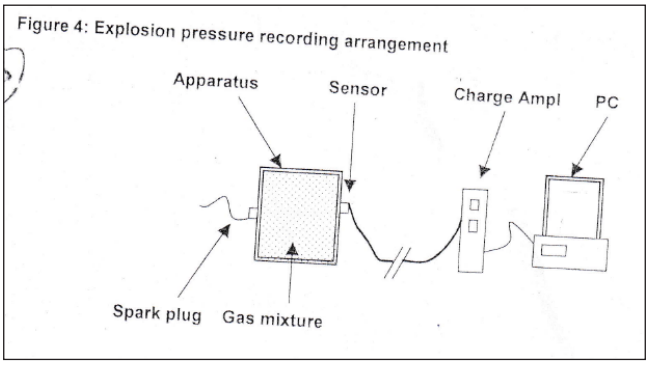


*Figure 3: Explosion pressure recording arrangement*

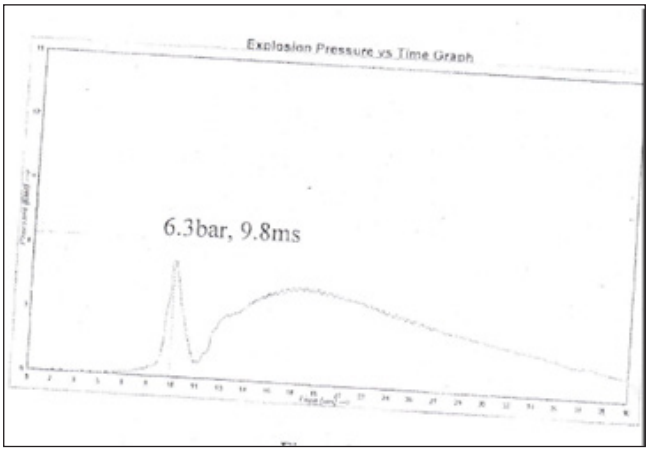


*Figure 4: Maximum pressure developed inside in enclosure*

**Overpressure Test**

The maximum explosion pressure is called reference pressure because taking this into account the empty enclosure is tested at a overpressure hydraulically. This overpressure test is 1.5 times

of reference pressure or 3.5bar/cm$^2$ whichever is maximum for at least one minute. No selling, deformation or damage or leakage should be observed through the wall or cover of the enclosure.

**Non-Transmission of an Internal Ignition**

Each joint of the flameproof apparatus should have minimum length and maximum gap as required in the standard based on the volume and gas group. This minimum length of joint is called flame path through which the flames will release its heat to the surface or body of the apparatus such as its temperature is less than the ignition temperature of the gas atmosphere. To check this feature, flameproof apparatus is placed in an explosion chamber or enclosed in a polythene bag. The test is made with the same flammable mixture inside the enclosure and in the explosion chamber. The mixture inside the enclosure is ignited by a low energy spark plug. The test is considered to be satisfactory, if the gas, mixture present in the surrounding explosion chamber is not ignited. After the test, the mixture in the chamber is deliberately ignited to confirm that outside atmosphere of the equipment is hazardous. At least five tests are made. The mixture in the enclosure and if necessary, in the explosion chamber, being renewed for each test. The percentage of gas mixture used for this test is as follows: (37±0.5)% Hydrogen in air.

**Impact Test**

The weakest parts of the apparatus like glass parts, cable entry bosses, Indicating Lamps, Switches etc., are subjected to mechanical impact test by freely dropping a mass of 1kg from appropriate height to create impact of 7Joule for metal parts and 2 Joule for glass parts provided with guard and 4Jouls incase of glass parts provided without guard. This test is satisfactory if it does not violate type of protection of the apparatus.

The height of fall for various impact energy requirements may be estimated from the relationship: h = E/mg.

Where, H = height in m, E impact energy in Jule, m is mass in kg, and g = 10m/s$^2$

**Temperature Class Test**

The flameproof apparatus is tested at full load and between 90% to 110% of rated voltage for determination of maximum surface temperature attained during the service. The junction boxes or terminal boxes with terminals are supplied with 110% of rated current. Other equipment like lighting fittings are supplied with 110% of rated voltage by fixing lamp of appropriate rating. The surface temperature is measured at each half an hour interval at different locations. When the difference between two consecutive readings is $1^0$C/hr w.r.t. ambient temperature, the test is stopped and the final reading is measured. The maximum of all readings from all locations is considered the maximum surface temperature and the temperature class is classified. The T-class and corresponding maximum temperature is listed in Table-1. In case of increase safety apparatus the maximum temperature of the internal component (winding temperature in case of motor or terminal temperature in case of terminal boxes) is considered for classification of T-class.

**Thermal Shock Test**

During thermal shock test water of $10^0$C is splashed by a nozzle of 1mm diameter on the glass part when the apparatus is at its maximum service temperature. As a result the glass should not crack.

Table 1: Temperature classification

| *Temperature Class* | *Maximum surface temperature* |
|---|---|
| T1 | 450$^o$C |
| T2 | 300$^o$C |
| T3 | 200$^o$C |
| T4 | 135$^o$C |
| T5 | 100$^o$C |
| T6 | 85$^o$C |

**Frictional Non-Incendivity Test**

Due to its lightweight and non-corrosive properties light aluminium alloy (such as LM-6, LM-20) is a common material of construction for flameproof Junction Boxes, Control Panels, Light Fitting enclosures, etc. but, the elements like Magnesium can cause frictional spark if strikes with rusty surfaces. This resulted in exothermic reaction due to oxidization of magnesium. To ascertain the non-incendive characteristics of the material, sample is collected from the apparatus made of light alloy and dropped vertically along with a brass weight of 16 Kgs and from a height of 4 meters to the rusty steel plate into an explosion chamber. The explosion chamber contained 28% Hydrogen in air (for IIC) and 21% in case of IIB group. Tests were carried out in a special chamber containing rusty steel plate kept at an angle of $45^0$ to the horizon. No ignition of the hydrogen and air mixture should be obtained due to the impact & friction between the sample and rusty steel plate in all cases.

**Conclusions**

Before selecting the electrical equipment for drilling rig, the area classification and distance of zone from bore hole is necessary. The flameproof equipment can be installed anywhere in zone 1 and zone 2. If the motors are increased safety, they should only be installed in zone 2 areas. All the cables should be terminated into the flameproof terminal boxes, junction boxes either through double compression cable glands or through sealing boxes completely filled with cement or epoxy. Unused cable entries should be plugged with stopping plugs. Earthing terminals should be provided both internal and external to the apparatus. The equipment should be cleaned routinely to avoid excessive temperature rise of the surface due to accumulation of dusts. The bolts and covers should be tightly fixed. All apparatus should be protected against ingress of dust and water. Minimum of IP-65 for fittings, junction boxes, panels and minimum of IP-55 for motors is necessary to avoid any short-circuiting due to ingress of water or dust.

If the equipment installed on a rig are very old they must be submitted to a National test house for checking its flameproof features. The rust may be one of the reasons that could damage flameproof properties of an apparatus. Remember! a flameproof apparatus is designed to sustain explosion pressure without any deformation or damage. This test is always non-destructive. This test is only destructive if the apparatus was not at all flameproof and damaged during the test. Thank God! It' saved your rig.

**Acknowledgment**

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## Congratulations to the S SBhatnagar Prize Winners of 2020

**Prof. Abhijit Mukherjee**

The Shanti SwarupBhatnagar Prize for Science and Technology (SSB) is a science award in India given annually by the Council of Scientific and Industrial Research (CSIR) since 1958 for notable and outstanding research, applied or fundamental, in different fields including environmental science. The prize recognizes outstanding Indian work (according to the view of CSIR awarding committee) in Science and Technology. It is the most coveted award in multidisciplinary science in India. The award is named after the founder Director of the Council of Scientific & Industrial Research, Shanti SwarupBhatnagar.

The 2020 Prize in the area of Earth, Atmosphere, Ocean and Planetary Sciences was givent to two earth scientists: **Prof. Abhijit Mukherjee** from the Department of Geology and Geophysics of Indian Institute of Technology, Kharagpur and Prof. Suryendu Dutta from IIT, Bombay.
Dr Mukherjee's work in earth atmosphere, ocean and planetary sciences focussing on the exploration of groundwater for sustainable drinking water resources has been honoured through the award. Dr. Mukherjee's work in the area of groundwater exploration for suitable and sustainable drinking water sources has been widely acknowledged, nationally and internationally. Recently, his research group developed an AI prediction model for detecting Arsenic in groundwater in the Gangetic delta. The work finds mention in communications by the Jal Jeevan Mission. His research areas include Arsenic and other contaminants fate and transport: global-scale to laboratory-scale; Interaction of groundwater with sea and river water; Groundwater recharge and estimation; Groundwater evolution (flow and chemistry) of large sedimentary basins; Groundwater exploration, management and remediation; Urban Geosciences.

Prof. Suryendu Dutta has been given this award for his invaluable contributions in the fields of organic geochemistry and molecular palaeobiology. Prof. Dutta's innovation in the evolution of plant-derived terpenoids demonstrates how plant-derived organic matters are a major source of liquid hydrocarbons in many petroliferous basins of India.

# Technical Note

## Environmental Issues and Its Management in Coal Minig Areas

– R. K. Tiwary*

**1.0 Introduction**

Coal is the most abundant fossil fuel resource in the country. The coal occurrences in India are mainly distributed along the present-day river valleys *viz*. Damodar Valley, Sone-Mahanadi Valley, Pench-Kanhan Valley, Wardha-Godavari Valley etc. There are 69 major coalfields located in the peninsular India besides, 17 located in the north-eastern region. The bulk of the coal reserves are confined to the south-eastern quadrant of the country in West Bengal, Jharkhand, Orissa, Chhattisgarh, Madhya Pradesh and Maharashtra. The coal resources of India have been estimated by the Geological Survey of India at 326.50 billion tonnes (BT) up to the depth of 1200 m as on 01.04.2019, out of which– "prime" coking coal is 5.32 BT, medium coking 27.98 BT and semi-coking coal is 1.71 BT and non-coking coal 289.87 BT in addition to 1.62 BT of high Sulphur tertiary coals. 324.88 BT of these resources occur in Gondwana basin and the balance 1.62 BT in the tertiary formations (GSI, 2019).

Coal India Limited (CIL) is the largest public sector company, producing 81.27% of the total coal production. in the country. The Singareni Collieries Company Limited (SCCL) is a coal-mining company jointly owned by the Government of Telangana and the Government of India. The Singareni coal reserves stretch across 350 km of the Pranahita - Godavari Valley of Telangana with a measured (proven) geological reserve aggregating to 1.07 BT. It is currently operating 18 opencast and 27 underground mines in 4 districts of Telangana State (SCCL, 2020).

With the increasing use of coal as the main energy source, the environmental problems associated with coal mining and its utilization is of great concern. Countries like the United Kingdom, the United States, Australia, and Germany have well established regulatory mechanism, mandatory as well as voluntary, to enforce measures mitigating environmental impacts arising out of production, transportation and usage of coal. In the developing countries like China, India, Indonesia and Malesia the developmental activities received precedence over environmental considerations. This approach apparently had its own logic. It was said that in a situation where most efforts were being directed towards removal of the most serious form of pollution, namely, the poverty, the environmental issues should not be allowed to hamper quick economic growth. However, of late, awareness of ecological identity has become sharper and environmental considerations are being perceived as an integral part of the development process. Coal projects are now being carefully examined from the environmental angle before a decision on investment is taken and great concern is shown from the people as well as regulatory bodies (Dhar, B.B., 1995; Sachdev, 1995; Ravi, C. et al., 2011).

**2.0 Environmental Issues in Coal Mining Area**

The complete coal chain comprises of mining, preparation and processing, transport, usage and disposal of solid, liquids and gaseous wastes. Proper environmental protection measures are therefore, required to be integrated in each of the stages. At mining stage, land reclamation, restoration of surface damaged by subsidence and proper treatment of effluents are the minimum requirement for effective environmental protection including dust suppression and green area development. The environmental impacts of transportation of coal are more spread out, less identifiable and their quantification becomes difficult due to secondary pollution caused by the fuel (generally diesel oil) used by the transport system. Air pollution is the major concern, which needs to be addressed while environmental planning for coal transportation and usages.

* *Former Scientist, NREM, CSIR-Central Institute of Mining and Fuel Research, Dhanbad – 826 015, India*

The coal mining activities have brought into focus a number of environmental issues which, inter-alia, include:

- Land degradation, dump management and land Reclamation
- Impact on water resources including ground and surface water
- Impact on air quality
- Noise pollution
- Impact on flora and fauna
- Impact on social-cultural aspects
- Impact on habitat and rehabilitation of project affected people
- Subsidence and mine fires in underground mining area (Jharia and Raniganj coalfields)

**2.1 Land Degradation**

For reclamation of degraded lands for mined out areas and external overburden (OB) dumps in opencast mines and subsided areas in underground mines, the procedures and techniques as laid down in the EMPs are being implemented. The reclamation of land includes creating a new landscape compatible with the surroundings and preferably improvement over the original. It is also essential that land restoration is carried out concurrently with the mining operations. Besides, the subsidence damaged areas are scientifically managed through controlled subsidence and surface management. Massive plantation works are undertaken for eco-restoration of the mining degraded lands. Eco-restoration of mining area has been undertaken in large scale in coal mining area using latest scientific techniques.

Bulk of the potential power grade coal reserves are in Singrauli, North Karanpura. Ib valley, Talcher, Wardha valley, Korba and Godavari valley coalfields and form more than 80% of the coal production share from opencast mining and these coal fields cover vast tracts of forest land. The requirement of forest land is estimated to be about 30% of the total land required. Guidelines issued by the Ministry of Environment Forest and Climate Change, Government of India stipulate that the coal companies are required to undertake compensatory afforestation over an equivalent area in non-forest land or twice the area in degraded forest land (in case of non-forest land not being made available).

- OB generated should be staked at earmarked dump site and its height, width and angle of slope should be governed by the mine plan as per the guidelines of the Directorate General of Mines Safety (DGMS), Dhanbad, India.
- Reclamation of waste dump site shall be done in scientific manner with native species to maintain the slope stability, prevent soil erosion and surface runoff.

**2.2 Impact on Water Resources**

The main source of water pollution is from the effluents of coal mining and coal washeries contaminated with suspended solids, oil and grease etc. Damodar river, which traverses through all the major coalfields in Jharkhand and West Bengal has been seriously affected by pollution from effluents from mines, coal washeries, coke oven plants and other associated activities. The coal mining activity in many coalfields has resulted in lowering of ground water level and the consequent drying up/depletion of yield from wells in the vicinity. The problems of acid mine drainage, though not common, have been reported in Makum coalfield in Asam and few mines in Central India coalfield and in Pench-Kanhan coalfield and lignite mines of Gujarat (GMDC mines). Table 1 shows the mine water quality of three underground coal mines of Jharia coalfield. Mine water of coal mines generally contain high levels of TDS, $SO_4$, Fe and Mn, which need to be addressed before discharge to the surface or water bodies (Tiwary, 2001; Tiwary and Dhar, 1994) and Table 2 show the broader scenario of mine water quality of other coalfields (Tiwary, 2001) and generally contain high levels of TSS, TDS, Fe and $SO_4$, which reduces its applicability as drinking or any other purposes.

Table 1: Physico-chemical characteristics of Mine water in JCF (2014-15)

| Sl. No. | Parameter | Mine A | Mine B | Mine C | IS: 10500 |
|---|---|---|---|---|---|
| 1. | pH | 6.55-6.98 | 6.98-7.7 | 7.4-7.8 | 5.5 - 5.90 |
| 2. | TSS | 112-178 | 32-88.0 | 28.0-210.0 | 100 |
| 3. | BOD | 2.5-6.8 | 5.7-6.7 | 3.0-8.0 | 3.0 |
| 4. | COD | 58.7-96.8 | 132.6-177.43 | 110.5-308.3 | 250.0 |
| 5. | Zinc as Zn | 0.05-0.39 | 0.02-0.23 | 0.04-0.22 | 5.0 |
| 6. | Fluoride as F | 0.5-0.9 | 0.01-0.05 | 0.01-0.04 | 2.0 |
| 7. | Dissolve d Phosphate | 1.8-3.4 | BDL-2.3 | 2.3-3.5 | 5.0 |
| 8. | Sulphide as S | 0.4-0.8 | BDL-1.1 | 1.0-1.2 | 2.0 |
| 9. | Manganese as Mn | 0.18-0.27 | BDL-1.2 | 0.8-1.3 | 2.0 |
| 10. | Iron as Fe | 0.19-0.27 | 0.04-0.15 | 1.6-2.1 | 0.3 |
| 11. | Nitrate as $NO_3$ | 31.4-41.0 | 2.4-37.0 | 3.4-4.5 | 45.0 |
| 12. | TDS | 440.0-1200.0 | 470.0-1400.0 | 564.0-1800.0 | 500-2000 |

Note: All parameters are in (mg/L) except pH

Table 2: Physico-chemical characteristics of mine water in different coalfields

| S. N. | Parameter | JCF | RCF | CCL | TCF |
|---|---|---|---|---|---|
| 1. | pH | 6.50-9.22 | 6.98-8.99 | 6.70-7.30 | 6.80-7.10 |
| 2. | Temp. | 26.00-31.90 | 25.50-32.00 | 26.00-34.00 | 24.00-34.00 |
| 3. | TSS | 240.60-1180.00 | 10.00-182.00 | 10.00-528.00 | 136.00-352.00 |
| 4. | TDS | 459.00-796.00 | 348.00-860.00 | 200.00-670.00 | 136.00-278.00 |
| 5. | Oil and grease | 0.03-0.05 | 0.08-4.78 | 0.10-1.20 | 0.001 |
| 6. | BOD | 0.60-33.42 | 4.00-120.00 | 0.40-4.60 | 1.30-5.90 |
| 7. | COD | 21.05-235.20 | 9.00-340.00 | 18.00-53.00 | 13.40-46.30 |
| 8. | As | 0.001 | 0.001 | 0.001 | 0.001 |
| 9. | Hg | 0.001 | 0.001 | 0.001 | 0.001 |
| 10. | Fe | 1.30-3.10 | 0.28-4.20 | 0.25-1.77 | 0.13-0.29 |
| 11. | CN | 0.001 | 0.001 | 0.001 | 0.001 |
| 12. | Cl | 24.50-1009.00 | 27.00-73.00 | 20.00-69.00 | 15.60-44.70 |
| 13. | F | 0.10-1.50 | 0.28-1.30 | 0.60-1.40 | 0.50-1.30 |
| 14. | $SO_4$ | 206.00-401.00 | 14.00-379.40 | 25.00-185.00 | 10.20-25.80 |
| 15. | Hardness | 600.50-711.40 | 68.00-324.00 | 260.00-570.00 | 171.00-276.00 |
| 16. | nitrate | 40.80-58.00 | 12.00-41.00 | 0.11-4.60 | 2.80-15.30 |
| 17. | Coliform (MPN 100 m $L^{-1}$) | 17.00-2400.00 | 920.00-1600.00 | 12.00-1400.00 | 22.00-61.00 |

Note: All parameters are in (mg/L) except pH and Temp.

**2.2.1 Measures generally adopted to control water pollution**

Suggested control measures adopted for controlling water pollution are given below:

- Water settling pond should be constructed in and around the opencast mines for settlement of suspended solids and recharging of ground water
- Provision of soil and grease traps in the HEMM workshops for cleaning effluents and their subsequent recycling.
- Provision of garland drainage around the external OB dumps to collect the runoff water.
- Establishment and operation of effluent treatment plants in the mines having acidic mine discharges like in lignite mines.
- Operation of coal washing units on closed water circuits for conservation of water and reduction of pollution.
- Green area development at the boundary of mine lease area.
- Mine water reclamation is treated and practiced in accordance with CIMFR development to make it potable.

**2.3 Impact on Air Quality**

The Air pollution in the mining area is mainly due to opencast mining, transportation of coal and overburden material, due to coal handling plants and coal washeries. They are also caused by soft and hard coke making units. Particulate matters $PM_{10}$ and $PM_{2.5}$ are the main pollutants. During mining, most of the dust arises from drilling, blasting, excavation, crushing and transportation operations. Large quantities of dust become wind borne and are carried away from coal and overburden dumps. A study of the air quality in some of the mining areas shows that in many of the mining areas in the Jharia coalfield, the level of $PM_{10}$ and $PM_{2.5}$ exceeds the standards set by the Central Pollution Control Board for industrial area. The location map and variation in the air quality are shown in Figures 1 - 4. Ambient air quality of Jharia coalfield during 2014-15 has been shown in Table 3. It has been observed that pre monsoon, and post monsoon seasons face high level of air pollution in all the three mine sites but it reduces in monsoon season, which is due to obvious reasons of rainfall (Pradhan, 2012).

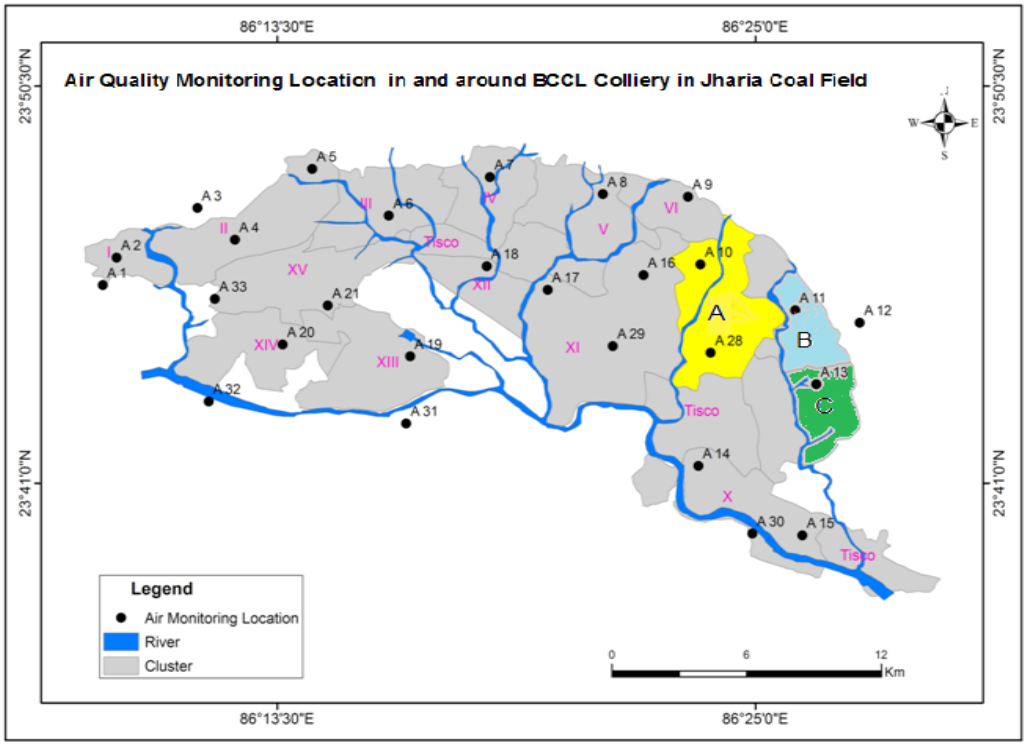


Figure 1: Location of Air Monitoring Stations in Mine A, B and C in Jharia Coalfield

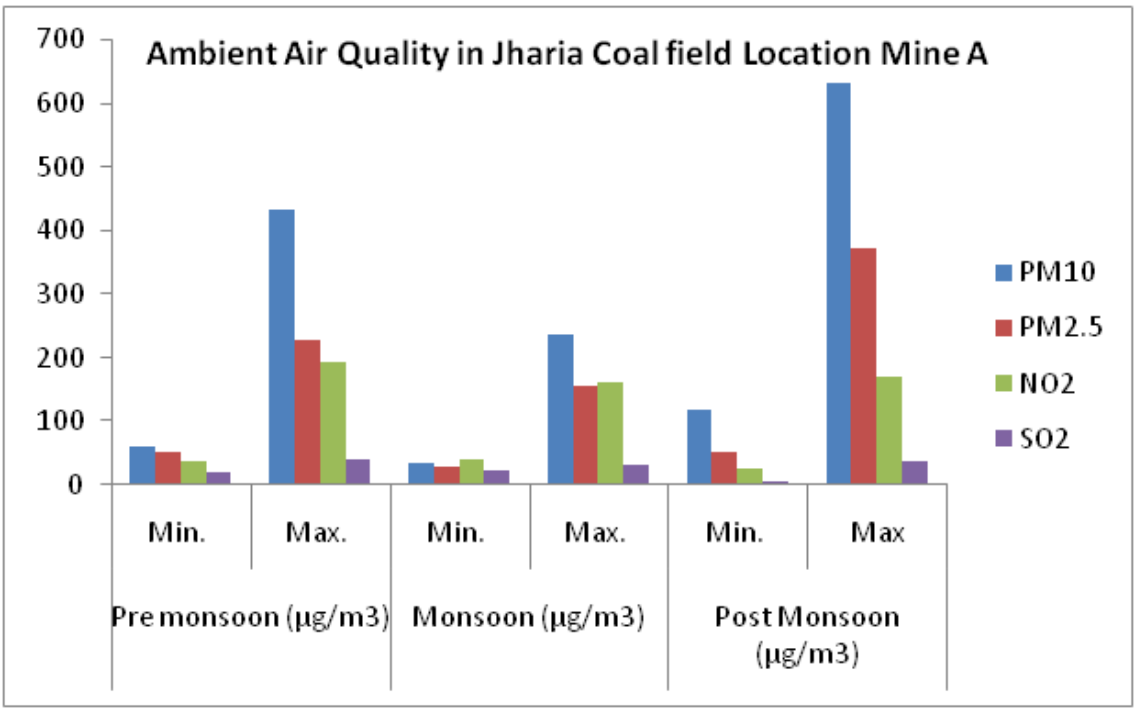


Figure 2: Ambient air quality Jharia Coalfield location mine A

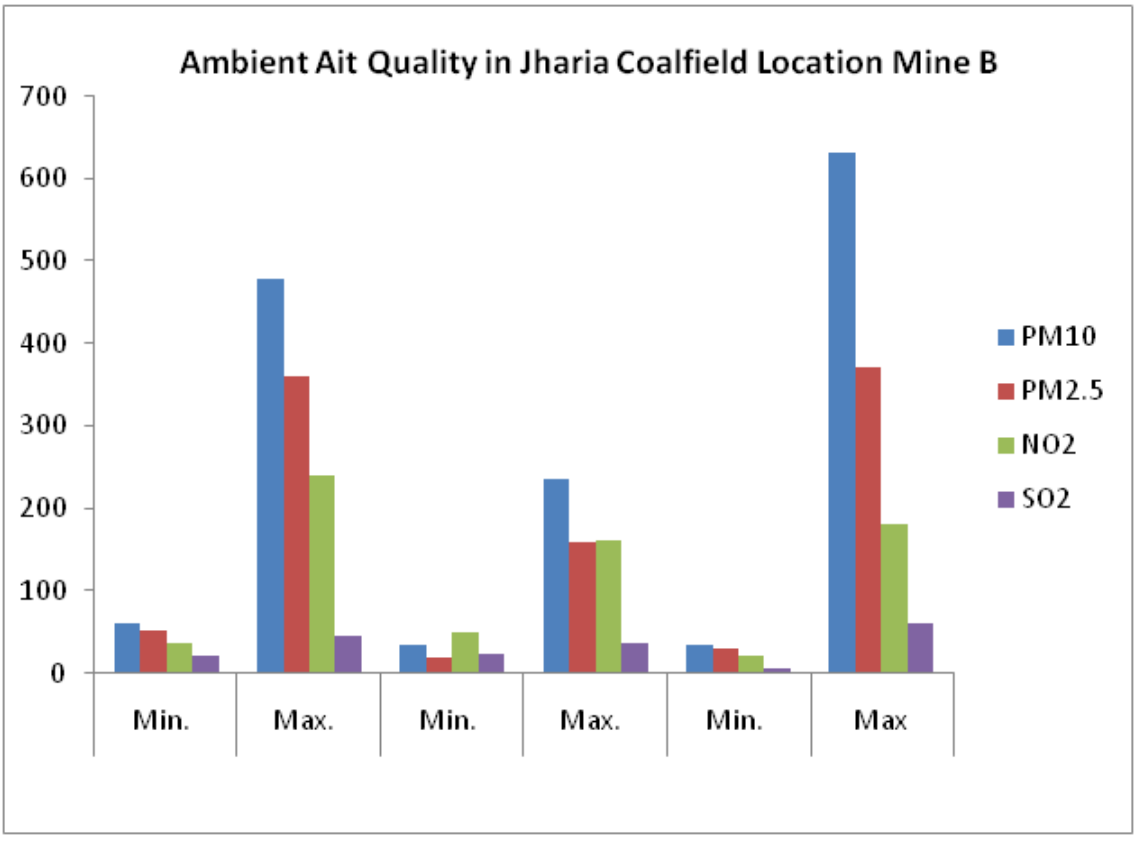


Figure 3: Ambient air quality in Jharia Coalfield location mine B

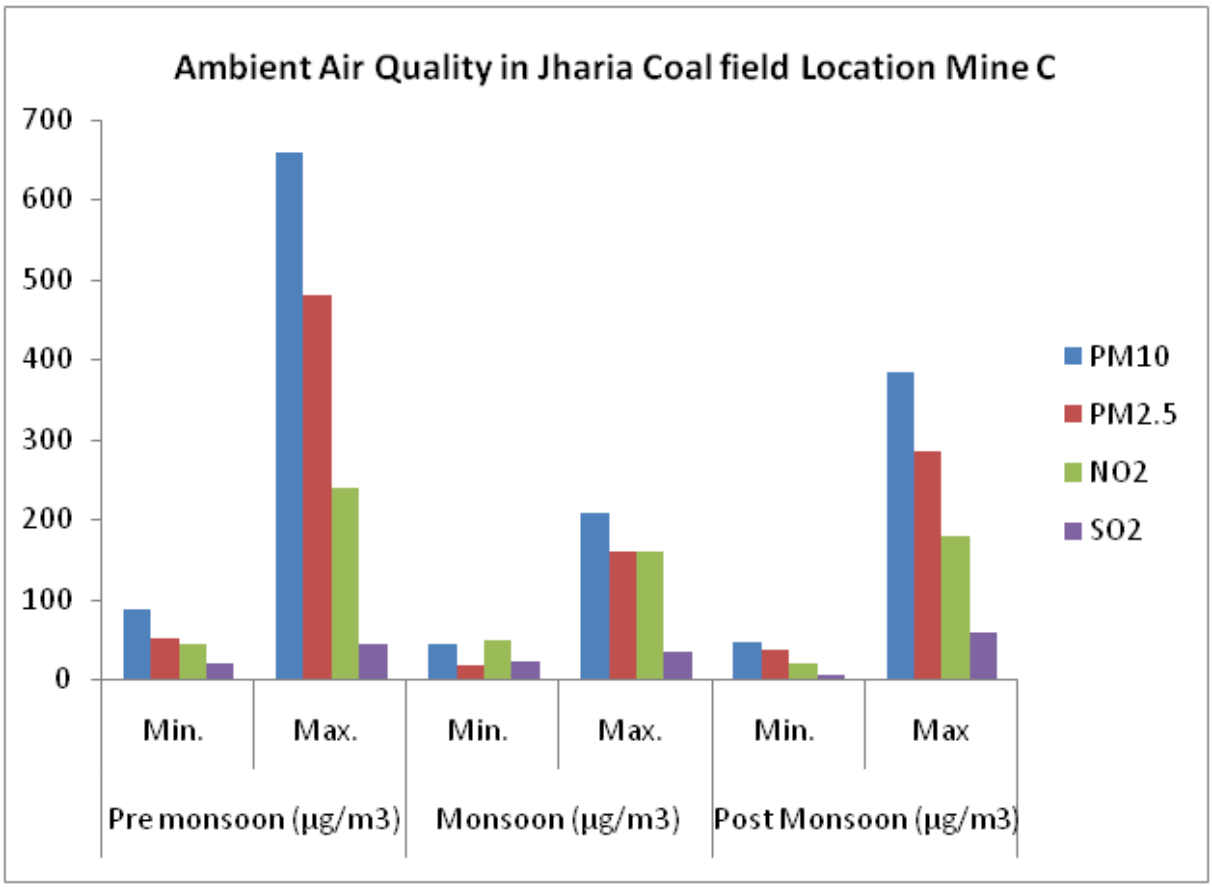


Figure 4: Ambient air quality in Jharia Coalfield location mine C

Table 3: Ambient Air Quality in Jharia Coalfield (2014-15)

| Location | Pre monsoon(µg/m$^3$) | | | Monsoon (µg/m$^3$) | | | Post Monsoon(µg/m$^3$) | | |
|---|---|---|---|---|---|---|---|---|---|
| | Min. | Max. | Average | Min. | Max. | Average | Min. | Max. | Average |
| **Mine-A** | | | | | | | | | |
| $PM_{10}$ | 61.0 | 432.50 | 246.75 | 34.08 | 236.53 | 135.305 | 119.91 | 632.22 | 376.065 |
| $PM_{2.5}$ | 52.41 | 228.08 | 140.245 | 30.00 | 155.78 | 92.89 | 51.62 | 372.10 | 211.86 |
| $NO_2$ | 37.57 | 194.99 | 116.28 | 39.34 | 161.14 | 100.24 | 25.95 | 171.88 | 98.915 |
| $SO_2$ | 21.07 | 39.70 | 30.385 | 24.22 | 31.61 | 27.915 | 6.48 | 38.39 | 22.435 |
| **Mine-B** | | | | | | | | | |
| $PM_{10}$ | 61.00 | 480.00 | 270.5 | 34.08 | 236.53 | 135.305 | 34.08 | 632.22 | 333.15 |
| $PM_{2.5}$ | 52.41 | 360.06 | 206.5 | 19.88 | 160.06 | 89.97 | 30.00 | 372.10 | 201.05 |
| $NO_2$ | 37.57 | 241.08 | 139.325 | 49.60 | 161.14 | 105.37 | 22.83 | 180.63 | 101.73 |
| $SO_2$ | 21.07 | 46.85 | 33.96 | 23.62 | 36.85 | 30.235 | 6.48 | 60.27 | 33.375 |

| Location | Pre monsoon(µg/m$^3$) | | | Monsoon (µg/m$^3$) | | | Post Monsoon(µg/m$^3$) | | |
|---|---|---|---|---|---|---|---|---|---|
| | Min. | Max. | Average | Min. | Max. | Average | Min. | Max. | Average |
| **Mine-C** | | | | | | | | | |
| $PM_{10}$ | 89.84 | 660.06 | 374.95 | 44.51 | 209.80 | 127.155 | 48.19 | 385.77 | 216.98 |
| $PM_{2.5}$ | 53.06 | 480.00 | 266.53 | 19.88 | 160.06 | 89.97 | 39.60 | 286.95 | 163.275 |
| $NO_2$ | 45.80 | 241.08 | 143.44 | 49.60 | 161.14 | 105.37 | 22.83 | 180.63 | 101.73 |
| $SO_2$ | 21.07 | 46.85 | 33.96 | 23.99 | 36.85 | 30.42 | 6.48 | 60.27 | 33.375 |
| $PM_{10}$ | 60 (Annual), 100 (24 Hrs) | | | | | | | | |
| $PM_{2.5}$ | 40 (Annual), 60 (24 Hrs) | | | | | | | | |
| $NO_2$ | 40 (Annual), 80 (24 Hrs) | | | | | | | | |
| $SO_2$ | 50 (Annual), 80 (24 Hrs) | | | | | | | | |

**2.3.1 Measures generally adopted to minimize air pollution**

Suggested measures adopted for controlling water pollution are given below:

- Watering of haul roads and other roads at regular intervals.
- Use of chemicals with spray water for effective dust suppression on the haul roads.
- Dust suppression by hydro-jet spraying at receiving pit, loading point etc.
- Spraying of permanent transport roads at required frequencies by fixed mechanical sprays.
- Provision of green belt by vegetation for trapping dust.
- Provision of hydro-Jets and other dust extraction/suppression arrangements in mechanized underground faces (CIMFR has developed dust collecting system and being implemented in some of mines).

**2.4 Noise Pollution**

The most important sources of noise in mines and beneficiation plants are the diesel engine powered machines, compressors, pumps, fans, drilling machines, dumpers, crushers, screens, grinding mills etc. noise level in the range of 90-100 dB (A) in underground mines and 100 to 107 dB (A) in opencast mines are generated which are in excess of the permissible limit of 90 dB (A). Continuous exposure of workers to high level of noise may result in annoyance, fatigue, temporary shift of threshold limit of hearing, and permanent loss of hearing. Ambient noise level in Jharia coalfield has been depicted in the Table 4.

Table 4: Noise Level in Jharia Coalfield (2014-15)
Noise level in Leq dB(A)

| Location | Pre Monsoon | | Monsoon | | Post Monsoon | |
|---|---|---|---|---|---|---|
| | day | Night | day | Night | day | Night |
| Mine-A | 60.5-84.6 | 45.1-70.4 | 63.4-80.2 | 42.7-64.2 | 60.2-84.7 | 41.5-68.7 |
| Mine -B | 60.5-84.6 | 45.1-70.4 | 63.4-80.2 | 44.2-64.2 | 60.2-84.7 | 38.5-68.7 |
| Mine -C | 61.2-84.6 | 40.9-70.4 | 63.4-74.2 | 40.3-53.6 | 57.6-81.2 | 38.5-68.7 |
| Ambient Noise Standard | 55 B (A) Leq during 'day time' and 45 dB (A) Leq during 'night time | | | | | |

**2.4.1 Measures taken for abatement of noise level in mining area:**

- Proper maintenance of plant and machinery
- Improvement on design of machines.
- Lining of chutes in coal handling plants for noise absorption.
- Acoustically designed operator's cabins in HEMM.
- Use of personal protective devices i.e. earmuffs by workers, working in high noise activity centers.
- Creation of wide green belts of dense foliage between mine areas and residential colonies.

**2.5 Impact on Flora and Fauna**

Increasing level of dust in the form of fine coal particles and Mine Water discharge having high level of TSS & TDS affect both flora & fauna including aquatic fauna. Mining in Makum coalfield in Assam, Central India coalfields in Madhya Pradesh etc. involved considerable tracts of forest land there by endangering the habitat of wild animals like tiger, cheetah etc. at Sonawani, Duman Hill, korea, Jamuna, churcha and Katkona collieries. Coal mining is a site-specific activity and has to be carried out economically wherever coal deposits occur. However, necessary safeguards are required to ensure least disturbance/ damage to forests. Whenever it is inevitable, compensatory afforestation is required to be carried out. Forest conservation Act, 1980 was enacted to ensure necessary safeguards to see that the forest area is not un-necessarily used for non-forest uses.

**2.5.1 Green Belt development**

Green belt should be developed in 7.5m wide safety zone all along the periphery of mine lease area as per the guidelines of CPCB in order to arrest dust and noise pollution emanating from the mining activities. Plantation should also be carried out in backfilled reclamation area, around water bodies and along the transportation road by planting native species. One should undertake precautionary measures for conservation and protection of endangered flora & fauna and schedule 1 species during mining operations.

**2.6 Socio-Economic Aspects**

Large investment in the coal sector for opening up of new coal projects to meet the increasing coal demand have brought about boom town effects in Singrauli, Korba, Wardha and Jharia coalfields. Talcher coalfield also have the same effect. Mining in Rajmahal, North Karanpura coalfields have, to some extent led to socio-cultural alienation affecting the life styles of the tribals residing in and around these coalfields. Coal India is addressing this issue by doing community development and by assisting in building up infrastructural facilities for education, health care and communication (Nath, R., 2014).

Occupational health survey should be conducted at regular interval like x-ray chest, Audiometric, Blood lead level, ophthalmological assessment and Manganese assessment by neurologist.

**2.7 Impact on Habitat and Rehabilitation of Project Affected People (Paps)**

The impact of coal mining on the social environment is as abiding as the bio-physical environment. It is, therefore, necessary to study the social-economic status of the population likely to be affected by the coal mining. There is a need of clearly declared policy in this regard. There have been guidelines from the Government of India and from the State Governments regarding the rehabilitation of the affected people. Based on the standard World Bank guidelines, CIL have formulated a Rehabilitation & Resettlement (R&R) policy which is based on the principle that the compensation and benefits offered to the people affected by the coal project will be at least equal to and preferably better than that prescribed by the laws and guidelines of the central and State Govt. The main objective of coal India's proposed Resettlement and Rehabilitation policy are:

a) Minimizing disturbance of the local population be exploring alternative sites and project designs;
b) Project affected people improve or regain their former standard of living and earning capacity after a reasonable transition period;

c) Involuntary resettlement is executed as a development programme with project affected people being provided adequate resources and opportunities to share benefits from the project.

The R&R package covers a range of project affected people like land owners including tribals, landless people who derive their livelihood from the land to be acquired including tribals who are dependent on forest produce and persons whose homestead is acquired. Suitable rehabilitation assistance, jobs to land less PAPs in special cases and community facilities and services are the other benefits covered in the package, the main objective of the PAPs. The resettlement and rehabilitation plan is to be monitored and evaluated periodically after the completion of the land acquisition process (Nath, 2014).

**2.8 Transportation and End Use of Coal**

The increasing use of coal particularly of high ash content has adverse environmental impacts arising from emissions of PM, $SO_x$, $NO_x$ and other pollutants as well as large volume of ash is generated on burning. As coal will continue to be main source of commercial energy in India, there is an urgent need to initiate steps to reduce emissions of $CO_2$ which is a predominant Green House Gas (GHG). The International Conventions on Biodiversity and climate change as well as the Montreal Protocol to which India is a signatory have highlighted the need for concerted action in a time bound manner for overcoming the problems of climatic change because of concentration of Green House Gases and Ozone depletion. This can be reasonably achieved through improvement in combustion efficiency of coal in the power stations boilers through use of beneficiated coal (Pradhan, G.K., 2012).

**2.9 Utilisation of Washery Rejects**

The rejects generated on beneficiation of coal contain some unburnt coal. In case of three products washing of coal for steel plants, rejects have heat value around 1800 Kcal/Kg which is considered adequate for utilization in Fluidized Bed Boilers. Two captive power plants of 2x10 MW capacities each based on washery rejects have been set up and several more sites for such plants have been identified. In case of non-coking coal where heat value of rejects is rather low, of the order of 1000 Kcal/kg, some other usage like brick burning will have to be identified for rejects.

**2.10 Efficient Utilization of Coal**

Since coal consumption will continue to increase it has become necessary to switch over to more efficient, as well as environmentally friendly, coal combustion technologies. Some of the technologies already established in advanced countries are Pressurized Fluidized Bed Combustion (PFBC): Slurry Combustion and Integrated Gasification Combined cycle (IGCC), besides the traditional technology of coal beneficiation. These can be applied to the new power plants to be set up in India by the private sector. Similarly, Coal Bed Methane (CBM) is an exciting potential source of clean fuel in India. CBM resources in India are estimated to be of the order of over a trillion cubic meters, mainly in the Lower Gondwana coal basins. A number of Indian and foreign companies have shown interest in this field. various companies have already been given permission for exploration, development and extraction of Coal Bed Methane in India.

**3.0 CONCLUSION**

Coal will continue to be dependable and economically available fuel of long-term supply potential for generating electricity and for many industries. With increasing consumption of coal the adverse impacts would become more and more pronounced in the form of increased land degradation and increased particulate matters, $SO_x$, $NO_x$, and $CO_2$ emissions besides creating huge accumulation of solid wastes, seriously affecting the local, regional as well as global environment. The environmental concerns arising from mining, processing, transportation and usage of coal are, therefore, required to be addressed in a more careful and detailed manner. Technological options are available for carrying out coal mining in an environmentally compatible manner. Serious efforts need to be made to tackle the issues

specially the concurrent reclamation of land and rehabilitation and re-settlement of PAPs. The key to continuing dependence on high ash domestic coal resources lies in immediately switching over to burning of beneficiated coal through adoption of efficient and cost effective coal cleaning technologies and simultaneously undertaking a time bound plan of action for introduction of clean and efficient coal combustion technologies. This is a must for achieving the ultimate goal of sustainable economic and social development.

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**coal miners smile as he produces coal for the refrigrator at your home keep working .....**

# Technical Note

## Environmental Issues in Dongri Buzurg Open Cast Manganese Mine

– Sanniv Shome[1], – Dr Khanindra Pathak[2], – Dr G. G. Manekar[3]

**Introduction**

Dongri Buzurg is one of the largest Manganese opencast mines of Manganese Ore India Limited (MOIL), which produces around more than 3 Lakh tonnes of run of mines (ROM) from the pit with more than 5 $Mm^3$ of excavation of overburden rock per annum. Rocks representing the lower part of the Sausar Group sequence viz. Tirodi gneisses, Sitasaongi and Munsar formation that occur in and around Dongri-Buzurg Mine. Lohangi formation is absent in this area. The Manganese horizon occurs at the stratigraphic contact of the Sitasaongi and Munsar Formations. Manganese ore is associated with Gondite, a regionally metamorphosed manganiferous and non-calcareous rock, characterized by spessartite (a manganese almandine garnet) and quarts with or without manganese silicates showing essentially bedded characteristics of enclosed politic meta-sedimentary rocks. Method of mining is with shovel-dumper combination and transportation of ROM to crushing and screening plant. The combination of various rock type (Granitic Gneiss, Tirodi Biotite Schist/ Muscovite Quartzite Schist) is present in the overburden dumps. The random analysis of dump rock shows as given below;

| Mineral | Percentage |
|---|---|
| Schist/ Gneiss | 60 – 70 % |
| Mica | 10 - 20% |
| Quartzite | 8 -10 % |
| Silica | 5-6% |
| Stones | 8-10% |
| Clay | 4-5% |
| Dust | 2-3% |

The overburden dumps has been stacked separately at various locations and some of the dumps have attended height of 62 m and found to be matured. The dumps have been formed since the year 1962 and there are many issues that require scientific attention. These include:

1. The surface characteristics of the consolidated old dumps area for assessing dump erosion impacts on the surrounding agriculture area with black cotton soil of 2-3 m.
2. The presence of boulders in the dumps and their unknown disposition requires analysis to assess any risks on stability of the dump
3. Detailed characterization of the metamorphic rock schist and gneiss in dumps to investigate commercial uses
4. Stability and optimal height and slope angles and required terracing should be scientifically established
5. Rapid bio remediation or development vegetation potential of the barren areas
6. Regional Hydro-geology impact of the altered geomorphology of the mining areas

This article reveals the current status of the area. An image of the said Dump is given below.

Fig 1- Images of the Dump from Different Angles

1 *Research Scholar, School of Environmental science and Engineering, IIT Kharagpur*
2 *Dr Khanindra Pathak, Professor, Dept of Mining Engineering, IIT Kharagpur*
3 *Dr G.G. Manekar, General Manager (Mines Planning), MOIL Ltd, Nagpur*

**Background of the Study Area Location**

The Area referred comprises of Core zone and Buffer zone of the Dongri Buzurg mines (Figure 1). The mine is located in Bhandara District of Maharashtra (India), about 120kms from the Nagpur and 25 kms from Tumsar Township. The area is approached by Metal Road which is motor able in all seasons. The mine is connected by a 7 KM long all weathered road to Goberwahi which in turn is connected through a system of state and National Highways to all parts of the country. The mine also has a broad gauge railway siding from the Dongri Buzurg station, which is connected to Tumsar Road Junction.

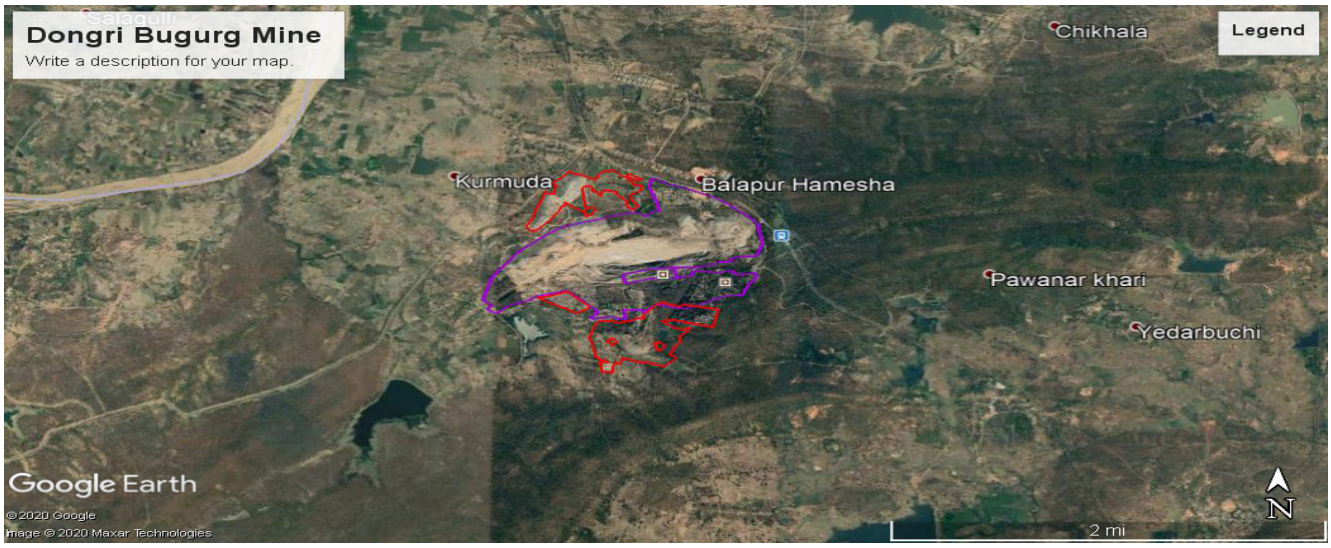


*Figure 2: Location map of the study area Jharia Coal field*

**Generalized Information of the Study Area**

There is 4 leaseholds of MOIL and total area is 173.8ha. Method of mining is mechanized. Shovel and dumpers are deployed for overburden removal and ore excavation. Currently opencast mining is carried out in 46.25 ha lease area in central portion of ore Body. Shovel Dumper combination and deep-hole blasting are used for bench formation and overburden removal.

The details of these four leasehold areas are provided in Table 1.

**Table 1- lease hold Areas of MOIL Ltd in the Dongri Buzurg Area**.

| Sr. No | Lease Area (ha) | Forest (ha) | Revenue Land (ha) | Private Land (ha) |
|---|---|---|---|---|
| 1 | 46.25 | 6.81 | 39.44 | - |
| 2 | 53.98 | 34.43 | 18.86 | 0.69 |
| 3 | 69.50 | 59.21 | 11.21 | 0.17 |
| 4 | 4.07 | 1.71 | 2.36 | - |

**Geology of the Study Area**

The leasehold area presents rolling topography with low lying hillock that extends from east to west. Rocks of Saucer series (Igneous rocks) have traversed a large Area of Balaghat and Chindwara districts in Madhya Pradesh and Bhandara and Nagpur d°istricts in Maharashtra. The Saucer Series extends from Balaghat district in the east to Chinndwara district in the west between longitudes 78° 49″ and 80°20″; Latitudes 21° 22″ and 22°05″ having a length of 210 Km and a width of 25- 30 Km.

The ore deposit is underlain by rocks belonging mostly to the lower part of the Meta sedimentary sequences of Saucer Series. The manganese ore is associated with gondites, a regionally metamorphosed manganiferous and non-calcareous rock, characterized by spessartite (a manganese almandine garnet) and quartz with or without manganese silicates, showing essentially bedded character and enclosed in peletic and psammitic meta-sedimentary rocks. The mine area

is representing an overturned southern limb of a syncline with older formation like Tirodi Gnesisses and Sitasaongi formation forming the hanging wall of the Manganese Ore. Mica Horizon and Mica Schist is forming the footwall as well as the core of the syncline. The strike length of the ore body is about 2150 m with the strike direction E-W. The thickness of the ore body ranges from 2m to 30m. It is the thickest in the central part and gradually taper down up to 2m at both the ends. The average dip of the ore body is 60° due South. The Manganese ore horizon occurs as a continuous bed at the stratigraphic contact of overlying Sitasongi formation and the underlying Mansar formation, on the reversed limb of a regional anticline.

**Topography of the Study Area**

The area is characterized by an undulating topography with average height of the ground level varying between 233m and 339m. Several micro catchments areas exist, in the area, as a result of the undulating topography in the area. These micro catchments area present a composite picture of the drainage pattern of the area. The land quality in the area can be enhanced by establishing an irrigation network in the area by using Bawanthari river water.

**Drainage of the Study Area**

The drainage of the area is mainly controlled by the River Bawanthari. This river is characterized by several streams and channels. Bawanthadi irrigation project is commissioned by the district irrigation department. This minor irrigation project will help in discharging irrigation water to the villages for growing paddy and sugar cane. It is understood that there will be significant boost in the village economy once this minor irrigation project becomes operational. By distributing irrigation water network of channels to the croplands the villagers can grow multiple crops throughout the year. The river course is dry as water is stored in dams in the upstream side.

**Land Use of the Study Area**

A land use Map of 1975 has been prepared using the Survey of India Topo sheet No. 55O/10 and 55O/11. Traditional agricultural practices are also in vogue in the fertile lands of the area. During 1975, most of the surrounding area was covered by dense forest but is has been extensively destroyed as revealed from 2011 data. The land use classes, area occupied by each class and percentage of each class of the total area are classified in Table 2 as follows.

**Table 2- The land use pattern of the study area during 1975 and 2011**

| Sr No. | Land use/land cover classes | Area 1975 | Area 2011 | Percentage of total area 1975 | Percentage of total area 2011 |
|---|---|---|---|---|---|
| 1 | Agricultural land | 29.9 | 42.84 | 38 | 54.64 |
| 2 | Dense Forest | 42.4 | 8.1 | 54 | 8.88 |
| 3 | Mines | 0.5 | 19.85 | 1 | 23.3 |
| 4 | River | 2.2 | 1.90 | 3 | 1.90 |
| 5 | Villages | 1.7 | 1.8 | 2 | 1.8 |
| 6 | Water body | 1.7 | 2.40 | 2 | 3.06 |
| | Total | 78.4 | 1.52 | 100 | 1.94 |

**Change in Land use due to Mining in the Study Area**

Due to increased mining activities, there has been change in land use pattern of the study area. Green land has been converted for other purposes. A detailed distribution is given in the Table 3 as follows.

| Land use/Land Cover Change | | Area Change ( sq km) |
|---|---|---|
| From (1975) | To (2011) | |
| Dense Forest | Agricultural Land | 11.8 |
| Dense Forest | Village | 0.3 |
| Dense Forest | Degraded Forest | 6.6 |
| | Total Change | 18.7 |

Land use/ land Cover pattern of the study area has changed by 24% of the 5 km buffer zone over a period of 36 years.

**Environmental issues related to the mines**

**Waste Dump Management under the mines**

An area of about 99.80 Ha is earmarked for dumping waste rock. It is systematically filled with muck keeping a bench height of 15 m. and width of about 30 m. once the height of the bench reaches the preceded configuration, the top bench is earmarked for plantation in the subsequent year and as such the reclamation and stabilization of dump with afforestation closely follows the active dump area.

**Top Soil Management**

The Dongri Buzurg Mine is located in a hilly terrain. This species is normally growing in rocky and sandy soil, therefore it is very little useful for mass plantation. Historically there was no cultivation in the mine lease hold area showing the fertility of the land, however, as small patch on the foot hill have been found to be cultivable. This land is being purchased by the company to acquire area for dumping and also for obtaining fertile soil for plantation and other social forestry purposes. The company has purchased around 65.57 Ha. of private land till date out of which 60.22 ha is converted into lease. These lands are situated about a kilometer away from footwall and hanging wall of the ore body.

**Reclamation and Rehabilitation**

The Mine Spoil dumps are located mostly in barren lands comprising of quarzitic and lateritic pebbles on revenue lands purchased from the local farmer. The fertile top soil from revenue lands are removed and used in mixture for application in Integrated Bio-technological Approach (IBA) to fill the pits. A layer of about one feet is also laid over the spoil dumps for increasing vegetation. Amendment of mine spoils with sugar mill waste (Presumed) at the rate of about 100 tonnes per Ha. increases the moisture holding capacity and helps root proliferation. As such the land is not only reclaimed but the fertility is increased manifold. Till date 81.47 Ha. Area is covered with plants and vegetation. Area under active dump will be reclaimed in the future after reaching its maximum capacity. The plants surviving in afforested area is about 1800 to 2000 Nos. per hectors having better health and growing capacity. Therefore, there is a high level satisfaction for rehabilitation of plants. The fruit growing trees are also being planted to attract the fauna and as such reclamation and rehabilitation programmed for the mine is closely following the mine activities

not only to maintain the present level of Flora and fauna but to increase the same minefield with socio-economic benefits. The figure given below depicts the plantation over the dump.

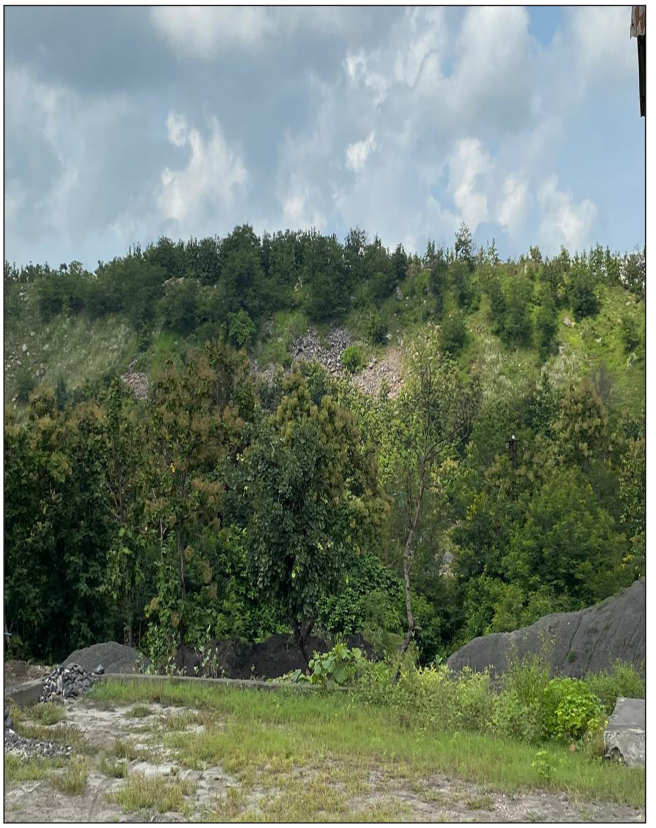

*Fig 3 Plantation over the Dump in Dongri Buzurg Mine.*

**Water Pollution Management**

The entire mine topography is hilly with steep as well as gradual dipping slopes. There are no prominent water courses within mine and rain water during monsoon drains into nallah through a network of storm water drain. The mine water is pumped out in to the settling pond, which is located immediately to the south of crushing and screening plant. During dry season only a small quantity of ground water will percolate into the pit and accumulate into the sump. It is pumped out and used for dust suppression purposes. The quality of effluents is being monitored from time to time. The steps to be taken for protection and stability of tailing dam, stabilization of tailing material and its utilization, periodic de-silting measures to prevent water pollution from tailings etc.

**Noise Pollution**

Mitigation measures for noise and ground vibrations are of following types:-

1. Prevention at source
2. Noise is best abated at source by choosing machinery and equipment suitably, by proper mounting of equipment & ventilation systems and by providing noise insulating enclosures or padding where practicable.
3. All machinery, vehicles and equipment used in the mine are fitted with appropriate noise controls that are maintained regularly and serviced to the manufacturer's specifications.
4. A green belt around the mine boundary is developed to check the noise and avoiding any inconvenience to the settlements.

**Air Pollution Management-**

The points of dust generation are:

1. Blast hole drilling,
2. Blasting,
3. Loading of Waste,
4. Haulage of ore, waste rock and soil,
5. Crushers and ore processing plant,
6. Dispatch of ore in trucks.

Dust suppression of these points is ensured by

- Wet drilling of blast holes
- Waste rock is wetted before loading
- Haulage roads are frequently sprinkled with water

Dust suppression through bag filters is being done at the crushing and screening plant

Regular maintenance of vehicles and machineries is carried out in order to control emissions

A fully equipped workshop is being provided in the mining area for timely and proper maintenance of all machinery with effluent treatment plant (ETP)

This proper maintenance will ensure gaseous exhaust at minimum level.

- Green belt development is taken up all along the haul roads and overburden dumps.

## Conclusion

This technical note reveals that mining is associated with major geomorphologic transformation and changes of land use land cover. Scientific efforts are necessary to convert the mine induced waste lands or solid wastes into wealth to ensure sustainable developments in the post mining periods.

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**To participate or to speak in the SMART-2020 MGMI members may contact**


**Prof. Shantanu Patel , Dept. of Mining Engg.,**
**IIT Kharagpur, India**
**Tel: (M) +91-8447986033**
**Fax: 0091 03222 282700**
**shantanu.patel@mining.iitkgp.ac.in**

# Bio-Sketch

## A Humble Tribute to Late Sri K. Krishnanunni Former Director-General, Geological Survey of India, an Authority on Remote Sensing and Above all A Great Human Being

***KRISHNANUNNI - A BIOSKETCH***

BY SCORES OF HIS ADMIRERS

**Sri K. Krishnanunni,** Former Director General, Geological Survey of India breathed his last on 4th June 2020 at his native place Palakkad in Kerala. He was a brilliant student and always stood first in school and college **and was** the topper of the first batch UPSC examination held in 1964 for recruitment in the Geological Survey of India. He was also topper of the batch in the training programme in the Indian photo-interpretation Institute at Dehra Dun in 1968-69, which earned him a fellowship at the International Training Centre, Delft, the Netherlands for pursuing another M.Sc. course.

He was a great visionary, as can be seen in the establishment of National Remote Sensing Agency (NRSA) in 1976-77 or in setting up of Regional Remote Sensing Service Centres (RRSSC) under ISRO. His greatest contribution to the Geological Survey of India and the society is the conception of development of village economy through mineral assessment programme DOVEMAP aimed at improving village economy and creating employment opportunities in rural area. The idea was appreciated by many decision makers but not followed due to extraneous reasons.

Sri Krishnanunni was a great human being and was at ease in talking with likes of Prof. Dhavan, Prof. U.R. Rao and senior bureaucrats in the Government as well as Group D employees of the Department.

His knowledge and informal attitude won him many admirers across the country, who decided to institute memorials to perpetuate his memory and vision by suitable publications, organising memorial lectures and awarding fellowships to the needy students. When approached by them, MGMI, Kolkata readily agreed to provide space in the forthcoming volume of MGMI News Journal for a Bio-sketch of Sri Krishnanunni. Accordingly, it was compiled based on the inputs of the following close associates of yesteryears and lifelong friends of Sri Krishnanunni – *S/Sri Subhas C. Verma, Prakash K. Shrivastava, Akshay K. Mukherjee and Gouri P. Ghatak* 1962 Batchmates (ISM - Dhanbad), *Sri N C. Shekar and Dr. Ajoy Kumar Moitra,* (GSI, Gujarat Circle, Ahmedabad), *Sri D.N.Setti and Sri J. K. Bhalla,* (GSI Central Hqrs., Kolkata), *Sri S. Raghunathan* (NRSA, Hyderabad), *Ms Geeta Varadan and Dr. Udayraj* (RRSSC, ISRO) and *Sri. Vimal Kumar and Sri Y. Kumar*, (North-Eastern Region, Shillong). We are indebted to the

family members of Sri Krishnanunni for providing some details of his early life, education and an adorable photograph of his younger days.

**Family and Early Education:**

Kalathinkal Krishnanunni, popularly known as Krishnanunni was born on 23rd March 1941 at Paravur, near Ernakulam, in Kerala. His father Prof. P. Kochunni Panicker was a Professor of History and Principal of Victoria College, Palakkad. His mother Smt.Sarojini Amma was

Krishnanunni in his younger days

a house wife.

After his early schooling in Paravur, he passed out the SSLC Examination, from Government High School, North Paravur (now Govt Boys' Higher Secondary School) with first rank in the school, and fifth rank in the then state of Travancore-Cochin. He studied intermediate at Union Christian College, Aluva and B.Sc Geology from University College, Trivendrum.

Krishnanunni in his younger days

**ISM Dhanbad**

The Indian School of Mines (ISM), now IIT (ISM) Dhanbad was established in 1926 by the British Indian Government, modelled on the lines of the Royal School of Mines, London. Sri Krishnanunni gained admission directly into the second year in ISM App. Geology course in July 1959, being a meritorious graduate in Geology from Kerala University.

Hailing from the deep south, he had some initial difficulty with the language spoken by fellow students in the class room or in the hostel in northern India, though the ISM students came from all parts of India. But Sri Krishnanunni was a quick learner of languages and adapted with ease to the long-standing traditions and milieu prevailing in ISM, Dhanbad campus. As for language, the first things he picked up were the lingo, jargon and slang vocabulary which are usually used by the more boisterous lot in a north Indian college. Though it may not sound too refined, but this type of language does help in quickly establishing a camaraderie and bonhomie between the students hailing from different regions and backgrounds. The fellowship and bond so established lasted for life-time, long after passing out of the college campus into a professional life at various places in different parts of the world. It is this trait practiced by Sri Krishnanunni that won him large number of pan-India friends and admirers throughout his career. Once integrated into the ISM student family, Sri Krishnanunni stood out as a very soft-spoken, affable, humorous, highly intelligent and serious student with enormous self-confidence and adaptability. He was calm and collected at all times. His personality and conduct endeared him to all - students and teachers alike. He kept up his academic brilliance and passed both the 3rd year final B.Sc. (Hons.) examination and 4th and final year, the M.Sc. and AISM Diploma examinations in 1st Division with merit. After completing M.Sc in July 1962, Sri. Krishnanunni, along with some of his batchmates was offered position in the Geology Department of ISM, where he worked as Demonstrator for a few months. Sri Prakash Shrivastava, his classmate in M.Sc., Applied Geology recalls that it was great fun working with him taking practical classes for 1st and 2nd Year students. In no time Krishnanunni befriended many young students and mentored them.

**Short stint in AMD**

In late 1962, Atomic Minerals Division (AMD) of the Department of Atomic Energy, Government of India advertised posts of Scientific Officer SB for

candidates holding a M.Sc. degree in Geology or a degree or AISM Diploma in Mining Engineering. Many ISM 1962 batchmates applied. Sri Subhas Verma, a batchmate of Sri Krishnanunni, holding M.Sc. degree in Applied Geophysics, did not meet the norms of the advertisement, but applied anyway. He got a call letter for interview, whereas Sri. Krishnanunni who was truly qualified did not get a call for interview – apparently due to some technical or administrative glitch or lapse. The interviews were held on 8th January 1963 in the South Block, Central Secretariat, New Delhi, Chaired by Dr. D.N. Wadia, a renowned geologist and Advisor to Government of India. Sri Krishnanunni reached the interview venue and represented his case successfully and was interviewed along with the others. All the ISM batchmates who had applied were selected. This event reflects Sri Krishnanunni's confidence, determination and ability to overcome obstacles**.**
By mid - 1963, Sri Krishnanunni joined AMD and was posted in Singhbhum Thrust Belt (Project -STB), Bihar (now Jharkhand), where detailed exploration for uranium was under way in different blocks.
While working in AMD, Sri Krishnanunni appeared for the first UPSC examination for recruitment of Geologists in GSI, in March 1964 and topped the list of successful candidates. He confided with close friends that the difference between him and the next rank holders was the marks he got in English. He left AMD in 1965 to join GSI in the Gujarat Circle at Ahmedabad. He maintained contacts with his ISM batchmates all along.

**GSI, Gujarat Circle, Ahmedabad**

Sri Krishnanunni's first posting in GSI was to the Gujarat Circle, Ahmedabad, where he joined as Geologist (Jr) in early 1965. It was a small circle office with about a dozen young officers in their twenties and Mr Vemban, Superintending Geologist, later re-designated as Director, a hard task master but affectionate and benevolent boss. Though Sri Krishnanunni was senior most officer after the Superintending Geologist, by virtue of his top rank in UPSC examination, there was great intimacy and camaraderie amongst all the young officers. A colleague of his in Gujarat days recollects that during the off-season, Sri Krishnanunni used to organise a weekly convention of his colleagues, in which each of them was to make a presentation of the work done during the previous field season. The author had to circulate a synopsis of his paper on the previous day. Here, it got a little more colourful. On the back of the sheet containing the synopsis, a mutually agreed menu of the high tea to be offered at the end of the lecture would be indicated. When the synopsis was circulated, everybody would flip to the back page first on which, besides menu, a question and answer (ragging) session was also enlisted. Like a true friend Sri Krishnanunni would help both sides, in preparing for the lecture as well as in amicably settling the menu and questionnaires.
Even at that young age, he showed exemplary leadership qualities. While Sri Krishnanunni enjoyed his carefree bachelor days like the rest of his friends, he was an intelligent and highly committed person, executing whatever assignment was entrusted to him with earnest sincerity. He also took great interest in what was being done by his colleagues in the Circle office to keep himself abreast of the latest developments.
He along with other top rankers of the first batch of UPSC examination was promoted as Geologist (Sr) in 1968. In the same year he was deputed to the Indian Photo-interpretation Institute, Dehra Dun for training in aerial photo interpretation for geology. He stood first among the trainees and was awarded fellowship at the International Institute for Aerial Surveys, popularly known as ITC, in Delft, The Netherlands for pursuing M.Sc course, which he accomplished with distinction. On return from the Netherlands, in March 1971, he returned to Gujarat Circle and continued there till early 1973. As No.2 in the Circle he used to look after the administration in the absence of the Director on tour or leave. By his informal and jovial attitude he used to make new recruits very comfortable in their job.
Following a demand by the local MP in the Parliament, a geological investigation was

included in the field programme of the Circle to carry out reconnaissance survey in the backward and tribal district of Dangs in south Gujarat. Sri Krishnanunni along with a young geologist Dr. Ajoy Kumar Moitra took up the investigation and proceeded to Ahwa, the district headquarters. It was found out that Sri Krishnanunni and Dr. Moitra were the first geologists to carry out geological investigations in the district which was highly inaccessible, densely forested hilly terrain. He was very serious in the job during the field work and used to discuss many geological aspects based on the field observations. After a hard day's field work, he used to discuss after dinner, a variety of topics like culture, literature, mythology, politics and wildlife suggestive of his versatile personality. He got married on 12th July 1972 to Ms. Lata who was equally pleasing and positive like Krishnanunni, a perfect match.

**GSI, CHQ Kolkata**

Sri Krishnanunni's stay in Kolkata was longest in his career in GSI. He was there in three spells, 1973-1984 (with a two-year break in 1976-77 when he was on deputation to NRSA, Hyderabad), 1989-1992 and 1998-2001.

He loved the city of Kolkata so much that he toyed with the idea of finally settling there. Kolkata then was and still is described lovingly as a city of lively contradictions, a melting pot of different cultures, generational values, polarized followers of political causes, economically disparate social groups, evolved trade union movements, multiple confusions and unanswered questions typical of a society which puts higher value on intellectual pursuits over material abundance. There would always be multiple perspectives on any issue with each person's view being uniquely emphatic. This capacity of the city to nurture multi-dimensional thinking on societal and economic issues has given India six of its Nobel Laureates. The city of such unique qualities greatly attracted Sri Krishanunni, befitting his own multifarious facets.

Sri Krishnanunni was transferred in 1973 from Gujarat Circle to Photogeology Division of CHQ which was a part of Map division. Soon after his joining the division was renamed as Photogeology and Remote sensing Division. It was catering air photo and satellite imagery interpretation services to different Regions of GSI besides carrying out its own research assignments.

**Deputation to NRSA**

Sri Krishnanunni joined as Technical Staff Officer to the Director NRSA in January 1976, on deputation from GSI. He was to assist the Director NRSA on all technical matters, their planning and realisation, which included facilities for remote sensing data procurement, processing and utilization and recruitment of suitable technical personnel. This was a crucial phase since the organisation was at its nascent stage having been in existence only for a few months.

Creation of facilities for organising indigenous aero-magnetic surveys and data collection for user agencies like Airborne Mineral Surveys and Exploration (AMSE) Wing of GSI and Atomic Minerals Directorate of Department of Atomic Energy were under way. Sri Krishnanunni was the principal scientist in planning for the surveys and interfacing with the users and also preliminary verification of the data collection to ensure that user needs were being met.

Sri Krishnanunni was actively involved in the discussions for procurement of airborne Modular Multispectral Scanner ($M^2S$) and Multispectral Data Analysis System by NRSA. He was also actively associated in planning of the facilities at Balanagar – the buildings, computer room layout, UPS facilities along with the diesel generator back up provisions – and other activities at that time. The $M^2S$ had a provision to generate a quick look film output using an equipment called visicorder. This could help in viewing the flight path and the area covered during the survey. Sri Krishnanunni utilised this output for these purposes and also to interpret the data in a preliminary manner over the area covered. He had extensive discussions with the other scientists on the geometrical distortions of the $M^2S$ data along the scanview angle and the effects of aircraft roll, pitch and yaw. He would visualise precisely the impact of

these on the picture elements (pixels) and wrote a detailed analysis paper on how to account for these in the image interpretation

**GSI, CHQ, Kolkata**.

On repatriation to GSI in early 1978 after two years deputation, Sri Krishnanunni was posted back in the PGRS Division of GSI, Central Headquarters. As in-charge of the Division, he provided guidance in the two national projects, preparation of lineament map of India and preparation of geomorphological map of India, both on 1:2 M scale by Landsat satellite data interpretation. Both the projects involved preparation of the maps by all the Regions of GSI on 1:500000 scale by visual interpretation of hard copies of the Landsat imagery of their respective areas and their compilation to 1:2 M scale national maps at headquarters by seamless mosaicing. The entire exercise was done by manual methods as digital processing techniques were not available then.

Another investigation carried out by the PGRS division under Sri Krishnanunni's guidance was "Project Indravati", one of the end to end experiments taken up under National Natural Resourses Management system (NNRMS) by the lead agency GSI using aerial photos, imageries and airborne multispectral data. Sri D N Setti was the coordinator for the project. Sri N.K Datta was involved in planning and execution of field studies in part of Bastar area. Sri Krishnanunni along with Sri D N Setti carried out, an investigation on preparation of geomorphological map of south Kerala coast, the only time he visited his native state, Gods own country, on official work in his long professional career. *The outcomes of these landmark projects won profuse appreciation of several eminent scientists. Professor Satish Dhawan, Chairman, ISRO was appreciative of GSI and its scientists for the early initiatives and commitment to use RS Technology. Prof. Pisharoty (father of Remote Sensing in India) was all praise for GSI Scientists in quickly adopting RS techniques even prior to the launching of IRS. and NNRMS. Much of this credit goes to Sri Krishnanunni*

Apart from his technical achievements, Sri Krishnanunni was equally involved in the welfare measures for fellow earth scientists. He was actively associated with GSI Scientific Officers Association (GSISOA). SOA was established by GSI officers during mid-sixties to draw attention of the government to multiplying operational difficulties in carrying out geological investigations in remote areas of the country and also lack of adequate system of career progression resulting in cadre distortions and acute stagnation at all levels. Sri Krishnanunni along with S/Sri S K Roy, Debasis Chaterjee, J K Bhalla, D N Setti and a host of other officers vigorously followed the efforts of the founders of GSISOA. Their greatest contribution to the SOA was the creation of GSISOA Welfare Fund aimed at rehabilitation of families of officers who lost lives while in service. The fund was financed by annual subscription from members of SOA, with the bulk of collections going towards payment of premium of LIC Group Insurance scheme, and the balance forming a corpus to meet operational expenses.

The institution of Central Government Employees Group Insurance Scheme (CGEGIS) by the GOI in 1980-81 was almost a replica of GSISOA WF, but with financial benefits several times higher has reduced the attraction of GSISOA Welfare Fund. Sri Krishnanunni made it possible to make some constitutional changes and by delinking LIC, ensured that all the additional benefits were passed on to only the families of deceased members.

**Transfer to AMSE, Bengaluru**

Sri Krishnanunni, on promotion as Director, was transferred to, PGRS Division, AMSE Wing, Bengaluru in 1984. Besides supervising the work of the officers of PGRS Division, he was extending technical support to the Dy. Director General.

Simultaneously, he was involved in regular consultations with Prof. Satish Dhawan, Chairman, ISRO and Sri Y.S. Rajan, Scientific Secretary to the Chairman on the implementation of recommendations of workshop on National Natural Resources Management System, held in 1983, and participated by various central and state government departments on the use of remote sensing data.

**Deputation to ISRO**

These discussions culminated to his joining ISRO on deputation as Director, NNMRS-RRSSC in early 1986, with a view to establishing Regional Remote Sensing Service Centres.

The main objectives of each Regional Centre were to provide support of digital infrastructure in processing Remote Sensing data, taking up of collaborative projects and providing training and capacity building exercises in their respective regions.

Five Regional Remote Sensing Service Centres (RRSSC) were proposed at Bengaluru, Nagpur, Jodhpur, Dehradun and Kharagpur, strategically located to cover the entire country. Sri Krishnanunni's first job was to seek financial and logistic support from the potential users of remotely sensed data in the Central Ministries and Departments, to support these centres. and he succeeded admirably. Accordingly, the Ministry of Mines agreed to fund the Bengaluru centre, National Bureau of Soil Science and Land Use Planning (NBSSLUP) the Nagpur centre, Central Arid Zone Research Institute (CAZRI), the Jodhpur centre, Department of Space the Dehradun centre and the Ministry of Science and Technology the Kharagpur centre.

*With Prof. Dhawan, Chairman ISRO, Sri.D N Setti and Dr. Radhakrishnan*

To man these centres Sri. Krishnanunni ensured a blend of experienced scientists from user Departments on deputation and freshly recruited talented young scientists were made available. They were all given 6 months orientation training at Bengaluru.

A state-of-the-art hardware and software configuration was procured for each of the centres. They were installed and operationalised after vigorous acceptance test procedure. Along with these five centres, 4 more centres were established with exactly identical facilities, at Chennai by the Government of Tamilnadu, at Lucknow by the Government of Uttar Pradesh, at Dehradun by the Forest Survey of India and at Hyderabad by the Department of Space. Once the Centers were made operational, the first task on hand was to establish the efficacy of digital interpretation vis-à-vis visual interpretation for various themes. After successfully establishing this, each of the five Centers formulated a number of theme-based application projects to be executed jointly with the user agencies in their respective regions. Simultaneously theme-based training programmes in digital image processing were formulated and training imparted to many users from Central and State government agencies and private industries to popularize digital processing of satellite data across the country. In addition, several software packages developed in house were installed at all the RRSSCs and state centers after due certification for undertaking the National level projects viz: Drought Mission, Landuse Landcover and Crop monitoring projects.

One of the prestigious projects taken up at that time was Project Vasundhara, a collaborative project between Geological Survey of India and ISRO aimed at prognosticating mineral targets by multi-theme data integration including digital image processing. The project proposal prepared by Sri Krishnanunni was highly appreciated by the then Chairman, ISRO Prof. U R Rao and Secretary, Ministry of Mines, Government of India Sri B K Rao. GSI has suggested 7 potential areas for the study for search of diamond, gold and base metals. Based on the results of data integration, GSI geologists followed up with ground checking. Scientists of RRSSC, Bengaluru developed a raster based Geographic Information System (GIS) called INGIS as a part of this project. Another important national project carried out

in RRSSCs was National Drought Monitoring Project undertaken by NRSC using NOAA satellite data. RRSSCs provided complete digital analysis support for the Project.

That the RRSSCs conceived and commissioned by Sri Krishnanunni, have now become Centers of Excellence for the application of geospatial technologies in the country is a fitting tribute to Krishnanunni.

After his 3-year tenure of deputation was over, Sri Krishnanunni sought repatriation to GSI. Reluctant to lose such a talented person, Chairman ISRO, Prof. U R Rao pleaded with him to stay back in ISRO, offering lucrative prospects. A firmly determined Krishnanunni politely rejected the offer as he knew that he was having better prospects in GSI.

**GSI, CHQ, Kolkata and Northern Region, Lucknow**

On repatriation from ISRO in 1989, Sri Krishnanunni was first posted at Geodata Division where he took measures to digitize the maps and reports and also convert legacy maps into soft copy form. In early 1991 he was transferred to the International Wing, where apart from routine duties he was coordinating the work carried out in different IGCP projects.

On promotion as Dy. Director General in August 1992, Sri Krishnanunni was posted in Northern Region, Lucknow and was soon made the HOD of the Region.

**GSI, North-Eastern Region, Shillong**

Sri Krishnanunni joined as Dy. Director General NER at Shillong in August, 1994. Right from day one, he had been thinking of some innovative programme which could be useful to generate employment opportunities in rural sector, besides the usual technical field investigations. In November, 1995, during a review meeting taken by Secretary (Mines) at Mangalore, he presented the idea of formulating such a programme by which there could be development of village economy through mineral appraisal. The plan was appreciated and a project named, "DOVEMAP" (Development of Village Economy through Mineral Appraisal Programme) was conceived.

The basic ideas of the project were discussed with the Secretary, North Eastern Council who agreed for partial funding of the project. The project commenced in F.S.1996 - 1997 and was continued for four years, covering more than 330 villages in Assam, Meghalaya and Tripura. The studies had generated enormous data on land use pattern, land suitability, groundwater and low-cost mineral potential. Thematic maps on geology, geomorphology, soil, land use and environmental hazards were prepared for each village on cadastral map base. The reports were distributed to the District Commissioners and Block Development Officers of the concerned districts, who greatly appreciated the efforts of GSI. A workshop on project DOVEMAP was held at Shillong in February, 2000.

Other major investigations initiated by Sri Krishnanunni included preparation of landslide zonation map of parts of north-eastern region, preparation of seismotectonic map of the north-east on 1:1 M scale and preparation of public awareness brochures in both English and local language for all the states in the Region giving details of geology, river valley projects and vulnerability to earthquakes and landslides.

Sri Krishnanunni was promoted as Sr. Dy. Director General in November 1997. Though he was required to move to Central headquarters, he preferred to stay back in Shillong till March 1998. He confided to close friends that his tenure in the north-east was the most satisfying period in his whole professional career.

*Farewell at Shillong*

**Back to GSI, CHQ, Kolkata:**

Sri Krishnanunni was transferred to the Central Headquarters, Kolkata in March 1998. He was very closely associated with the then Director-General, Dr. S, K, Acharyya in framing and execution of both technical and administrative policies within GSI and at the same time, interacting with the Secretary, Additional Secretary and other officials of Ministry of Mines.

GSI was facing a veritable existential threat since the early part of 1990s with the declared completion of first generation of systematic mapping of the country and at the same time, being unable to convince the controlling Ministry and Planning Commission the necessity of strengthening enormous data base thus generated with substantially larger inputs of field and laboratory data to work out and provide a geological configuration of the country and plan strategies for mineral exploration, environmental mitigation, infrastructure and other projects which require earth science inputs. Coordinated efforts by the duo of Dr Acharyya and Sri Krishnanunni between 1998-2000 resulted in Department Related Parliamentary Committee on Industries advising Ministry of Mines to set up an Expert Panel for Modernization of GSI.

Accordingly, an Expert Panel with Shri Krishnanunni as Chairman, and experts from GSI and other scientific and user organizations as members, was constituted by DOM in March 2000. The Expert Panel analysed the existing level of technical and equipment support system, knowledge base available in GSI, manpower situation, user expectations from GSI culled from a unique DELPHI SURVEY of around 350 organizations, academia and eminent individuals. The Panel submitted its report in a record three months' time. The Report gave its views on future requirement of type and quantum of geological, chemical, geophysical analysis, IT infrastructure, phasing of purchasing and financing schedules keeping in view future developments in analytical techniques and suggested several far reaching recommendations on the type of facilities to be created and managed. The deliberations during the meetings were always constructive and smooth and any difference of opinion was easily sorted out on account of respect that Krishnanunni commanded in all organizations. The Report of the Expert Panel has been an essential component of all future committees' deliberations set up with a view to improve GSI's working and all committees have drawn heavily from it in their recommendations.

He prepared a document on the role of the Ministry and the GSI in the project INDIGEO, a collaboration project with the ITC, the Netherlands aimed at capacity building of trained manpower in Geographical Information Systems (GIS), digital image processing and development of management skills in GSI.

In November 2000, considering that he would have only 4 months tenure as Director General, Sri Krishnanunni wanted to seek voluntary retirement so that the next person could get a full one year term .He carried the letter to the Ministry applying for voluntary retirement. To his surprise the Ministry gave him appointment order as Director General w.e.f 1.12.2000.

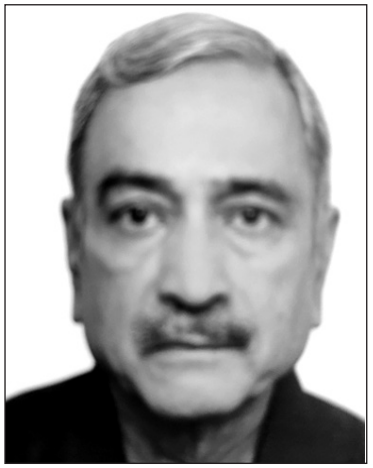

*Inaugurating seminar at Mangalore as Director-General*

After taking over as Director-General his first job was to plan celebrations on 150 years completion of the Geological Survey of India which he successfully organised in Central Headquarters, Regions and States.

After 36 years of yeoman service in the Department, Sri Krishnanunni superannuated on 31st March 2001

# Down The Memory Lane

– Er S. C. Agarwal



During last 25 years (1988- 2013) of my 50 years Industrial Career, I was associated with Dimensional Stone mining in Rajasthan. Joined the world's largest producer of Kotah Stone in Rajasthan. First as Dy General Manager, rose to General manager in 1989, then Vice President in 1998 and finally as President in 2003, and served till 2013 before opting for Superannuation. The organization was the largest producer of Kotah Stone in the world employing + 6000 persons, 85% local residents. During this journey of 25 long years there have been quite a few memorable events, like the one I am sharing.

Kotah Stone was accidentally discovered by a resident of a village called Suket in district Kota. The organization, I was associated ,was permitted to mine Kotah Stone in entire district of Kota by state ruler Maharav Bheem Singh as early as in 1925 and pay royalty to the ruler. Earlier Kota was called KOTAH. Hence the ruler named the Stone as Kotah Stone.

Later after the formation of State of Rajasthan, the Company was granted first lease No 1 by Department of Mines and Geology, Government of Rajasthan over an area of 20 sq km for 10 years followed by 5 renewal each for 10 years so that total lease period would not to exceed 60 years. Also the lease area was restricted first to 20 sq km then, 15 sq km and finally to 10 sq km.

Lease consisted of 6 blocks of which No 1 covered area of 7 sq km and remaining 5 blocks collectively measured 3 sq km. During earlier renewals when lease area was reduced from 15 sq km to 10 sq km, Bock remained unaltered and others 5 blocks were trimmed to size covering 3 sq km. The 5 blocks were though distantly located but within the geographical boundary of same Sub- Division of district Kota. Block No 1 was the best, rich, potential in reserves and recovery.

Lease area was demarcated in the area by officials of DMG by fixing lease pillars all around the area and distance between two pillars was measured and recorded. Area bound between pillars was computed to compute the lease area and recorded in the lease agreement signed by lessee and DMG official. The survey report is the part of agreement.

In 1959 when first time lease was granted, survey instrument used included Prismatic compass for angular measurements, and tape for linear measurements. For longer distances between two pillars, even the rope of measured length was used. After the first renewal, each boundary pillar was connected with local reference so that if pillar gets dislodged or destroyed it could be relocated and reset in original position.

During the renewal distance measurements were not done except the verification of position of lease pillars. Sometime in 1990 Complaints were filed by local residents and other lessee with DMG alleged that organization was illegally working out the lease area and demanded measurement of lease. Department constituted committee twice to re-measure the area but company lodged protest even to highest authority. Process though stayed but problem hang on. We had apprehended some problem because of change of survey instruments. Now survey would be done with modern instruments like Total Station or GPS, with high accuracy which may not match older instruments. This would create more problems especially in linear measurements.

To know present position of all boundary pillars, I carried out survey to check the position of pillar in all 6 blocks to establish the facts. After in-

house survey I was sure that pillars are at position as defined in the survey plan approved by Department of Mines & Geology GOR. . Anticipating that the problem may rise again, discussed with our legal consultant. Similar controversy rose in case of M/S Khetan Business Corp ( P) Ltd of Mumbai and was decided by Rajasthan High Court, reported RLW 2002 (3) Rajasthan 1556 in favour of lesse stating that Government can't demarcate afresh the lease after grant of lease. Renewal of lease was equivalent to grant of lease.

Our legal consultant was Paras Kuhad, most reputed legal consultant of Rajasthan. Retired Justice of High Court, of great reputation, was associated with this firm.He used to draft the writ petition but didn't attended Court but by other advocates .Writ- petition was drafted in advance so that it could be filed immediately after and if Government ordered enquiry establishing cause of action without any loss of time. As anticipated, day had come on 13.09.2004 when GOR instituted high level enquiry. Soon after we received official intimation, we filed the petition No 6283 in Rajasthan High Court. On behalf of organization, I, as president, signed the petition. Luck favoured us, our petition was listed for hearing on 15.09.2004. I briefed the Counsel and requested him that we should obtain stay against the Government order. The Counsel was in fact owner of the reputed legal firm. At later he was retained as Additional Solicitor General of Apex Court. Personally I never attended High Court, but as advised by Counsel I was present in the Court on the date and time.

After hearing our Counsel for 35-40 minutes, Honourable Justice K. S. Rathore said "You can't stop Government to check whether lessee is not working beyond the demarcated boundaries". Our counsellor replied "Yes sir, they may check the boundary pillars which were established by Government officials but not to demarcate the lease afresh. I was called to confirm this. Which I did. Having been satisfied Honourable Justice passed suitable order:

Operative part of order on petition No 6283 dated 15.09.2004

"Learned council for the petitioner submit that they have no objections if the respondents enquiry about mining lease belong to petitioner company with in the area specified by respondents but should not be allowed to make demarcation afresh contrary to the lease area and map approved by Mining Department.

Considering to the submission made on behalf of petitioners I find no fault in the request made by petitioners as the lease which has been granted in favour of petitioner under the provisions of Rajasthan Minor Mineral Concession Rules 1957 for a period of 10 years and the same has been extended from time to time and the area is specified and demarcated and pillars also erected on the area in accordance with the map approved by Mining Department.

The respondents Mining Department is at liberty to check the demarcation whether the petitioner is operating the mining within the mining area. Upon perusal of Annexure 10 of course it doesn't reveal that the respondents are going to re-demarcate the area but even otherwise also it is expected from the respondents to check the facts on the spot whether the petitioner is operating the mining activities beyond the area specified or not in accordance with the map , approved by mining department.

With these observations the writ petition stands disposed. Jaipur 15.09.2004 Sd/ Justice, Rajasthan High Court.

Our Counsel excitedly said "Mr Agarwal you wanted stay order, I got case decided in your favour.›

Definitely it was a great day for the Company facing threats, vindication and exploitation from politicians, Government officials and other lessee. Indeed it was a great day for me as President as well, because the case was hanging for more than a decade and my predecessors were managing the issue somehow by keeping everyone in favourable but in crisis no one came forward. It's also true story as how minor mineral mine owners are exploited, vindicated by politicians, may be for vested interest and whimsical perception of regulatory authorities.

# Upcoming Events

**Mining World Russia 2020**

**20 October 2020 - 22 October 2020**
24th International exhibition of machines and equipment for Mining, Processing and Transportation of minerals
Website: https://www.miningworld.ru/Home

**Paste 2020**

**02 November 2020 - 06 November 2020**
Paste 2020 is organising to offer a forum where executives and professionals can learn and analyse recent innovations on paste, thickened and filtered tailings management.
Website: http://paste2020.com/

**Connectivity 2020**

**10 November 2020 - 10 November 2020**
Connectivity 2020 is an online conference for professionals in the mining sector. As this is a completely virtual conference, you can join us from anywhere in the world, absolutely free.
Website: https://www.globalminingreview.com/connectivity2020/

**International Mining And Resources Conference + Expo (Imarc) Online**

**24 November 2020 - 27 November 2020**
To help the industry stay safe and stay connected, we have launched IMARC Online which will run from 24-27 November 2020.
Website: https://imarcglobal.com/

**IIT Kharagpur is organizing International Webinar , SMART 2020 with veteran keynote speakers from UK, Austria, Vietenam,China, Australia, Russia and galaxy of participants from Internationsl Mining Industry and Academics.**

**Dates:**
**16 December 2020: 4:00 pm, Inaugeral function followed by cultural program with international performers**
**17-18 December 2020: Number of technical Sesson covering themes:**

1. **Mining process optimization and improvement of productivity**
2. **Data Analytics, IOT and machine learning in mining: Industry 4.0**
3. **Geo-mechanics and smart devices for ground monitoring and improvement**
4. **Safety, health and environment: Sustainable practices**
5. **Mines to Mill: Technology towards zero waste generation**
6. **Resource evaluation, finance and trading**
7. **Mining machinery and mechanization**
8. **Mine automation and instrumentation**
9. **Society and mining: policy, law and governance**
10. **Novel mining system and disruptive technologies**

# MGMI TRANSIT HOUSE

## The Mining, Geological and Metallurgical Institute of India

GN-38/4, Sector V, Salt Lake, Kolkata 700 091
Phones : +91 33 4000 5168, +91 33 2357 3482/3987, Telefax : +91 33 2357 3482
E-mail : secretary@mgmiindia.in, office@mgmiindia.in, Web : www.mgmiindia.in

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|---|---|---|---|
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| Double Occupancy | Rs. 2,000/- | Extra Bed | Rs. 600/- |

2. 50% discount will be offered to MGMI member for self occupancy only.
3. Full tariff will be applicable for the nominee of MGMI member.
4. Full tariff for the employees of the Corporate Member or Patron Member.
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6. Caution money @Rs. 500/- per day, per room has to be deposited along with room rent in advance. This will be refunded in full or part thereof depending on the damage caused by the Guests.
7. Cancellation of confirmed booking Period Prior to date of Occupancy Cancellation fee to be deducted from advance

   a. Cancellation before Seven days 5%
   b. Cancellation before Three days 10%
   c. Cancellation before One day 25%

8. Check-in time 12.00 noon
9. Check-out time 11.00 a.m.
10. GST : Less than Rs. 1,000/- No GST
    Rs. 1,001/- to 7,500/- 12% (6% + 6% GST)
    Above Rs. 7,501/- 18% (9% + 9% GST)

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