

RECOMMENDATIONS FROM THE CONGRESS (8TH AMC 2019)

The 8th Asian Mining Congress, organized by the Mining Geological and Metallurgical Institute of India (MGMI) with the theme “*Green Mining – The Way Forward*”, was held from 6th - 8th November, 2019 in Kolkata. Based on the comments of Chairmen, Co-Chairmen and presentations by the authors and deliberations during different sessions, the Technical Committee constituted for the Congress framed the following recommendations:

Green Mining and Sustainability

- With the increasing concern for environmental degradation, it is felt that the mining industry must accelerate its progress towards “Green Mining”. Sustainability principles are applicable in all stages of mine life cycle –exploration, mine planning, construction, mineral extraction, mine closure and post-closure reclamation and rehabilitation. Regulations and Guidelines framed by the government as well as self-regulation and ethical conduct on the part of mining enterprises are most crucial for the achievement of sustainable mineral development.
- Sustainable development framework and Star Rating Scheme, as developed by the Indian Bureau of Mines, are novel steps toward sustainability of mineral industry. Detailed awareness and implementation programmes in this direction are very much required for transformation of the image of mining industry.
- Efforts need to be made to integrate Climate Change issues as part of the business model of mineral industries. For better alignment of Corporate Social Responsibility (CSR) projects towards United Nations’ (UN) Sustainable Development Goals (SDGs) of 2030, it is essential to enhance awareness about these goals amongst CSR managers and top management.
- Geospatial tools such as Remote Sensing, GIS, GPS, Digital Photogrammetry, etc., have proved very useful for spatial data integration, analysis, modeling and map production for monitoring and impact assessment of any mining operation.

Investments and Policies

- Zero waste Mining (conservation and mineral development) and sustainable development in mining sector, as envisioned in the National Mineral Policy 2019, must be adhered to. Moreover, formation of District Mineral Foundation (DMF) has to be geared up as it will facilitate inclusive and equitable development of project affected persons and areas as per the provisions of the Pradhan Mantri Khanij Kshetra Kalyan Yojana (PMKKKY).
- There needs to be instantaneous visibility of Smart Mining on production, quality, cycle times, machine status, and other variables in order to achieve optimum operations by adopting intelligent enterprise with Industry 4.0 concept.
- A uniform procedure for Minor Mineral Concession Rules should be formulated by the Central Government to be followed by all the State Governments to help the entrepreneurs carry out business in different States without hassles and confusion.
- Seamless transition from Reconnaissance Permit to Prospecting License to Mining Lease should be ensured to attract investors. Delay in processing mineral concession applications both at the State and Central levels should be minimized.
- Separate policies should be evolved urgently for exploration and mining of minerals of economic and strategic importance like Gold, Platinum group of minerals, Nickel, Lithium, Cobalt, rare earth elements etc.
- The outsourcing processes need to be reviewed to attract large established Mine Developer and Operators (MDOs) in the mining sector so that the mining industry can adopt the best practices available worldwide.

Exploration Technology

- Joint use of 3D geophysical inversion and 3D geological models should be employed for locating potential mineral deposits, with special reference to concealed and buried deposits at greater depths.

- Use of Geostatistics, Big Data, Artificial Intelligence and Machine Learning with special emphasis on Deep Learning is the need of hour for Smart Exploration. These need to be emphasized for thorough understanding of various 'Minerals Systems'.
- Recent discoveries in hydrocarbons sector in diverse geological settings, tough and inaccessible terrains together with advancements in exploration technology have added new dimensions in hydrocarbons exploration. Concepts of Geostatistics, Big Data, Artificial Intelligence and Machine Learning need to be emphasized for understanding of various 'Petroleum Systems'.
- Shale horizons of Barren Measures and Barakar Formation occurring below the upper Permian in Raniganj coalfield at depths greater than 700m are recommended for further investigation for possible CO₂ sequestration owing to sufficient hydrostatic pressure and high Total Organic Carbon (TOC). Pilot scale project(s) on CCS in this regard is recommended with special reference to Raniganj and Jharia coalfields.

Planning and Design of Mines

- Unmanned aerial vehicle (UAV) sensors, which are now in pilot scale, can prove useful in future for mine surveying and mapping.
- Systematic pit and dump slope stability studies, using state-of-the-art instruments and techniques, should be made mandatory for medium to large opencast mines to enhance safety.
- Underground coal mining needs large-scale mechanization to increase production and productivity. Continuous miner (CM) based mechanization can revive underground coal mining to certain extent.
- For extraction of coal reserves from greater depth, more R&D is required to address various issues related to design, operation and safety.
- Longwall technology should be customized with innovative layout to address pillar stability at greater depths and in greenfield areas.

Safety and Surveillance

- All machines in opencast mines must be tested for whole-body vibration exposure of operators so that prescribed limits as per the ISO standards are not exceeded. Further, machine parameters and occupation factors should be explored through ergonomic process of assessment to reduce the vibration exposure within safe limits.
- Trial of Web based real-time environmental monitoring for UG coal mines using wireless sensors (Wi-Fi system) can prove to be useful in future.
- Underground mining at deeper horizons require suitable R&D studies in the areas of air cooling systems, installation of booster fans and also changing of exhaust system to forcing system of ventilation to control excessive methane emission from goaf area. Mass production from underground mines would necessarily require greater thrust on effective ventilation.

Blasting and Rock Fragmentation

- Green blasting technologies like (a) Non detonating explosives, (b) Rock breakage using liquid CO₂ (c) Rock breakage using penetrating cone fracture and (d) Plasma blasting should be increasingly used in mines wherever applicable.
- It is required to develop model for prediction of peak particle velocity of ground vibration based on static and dynamic properties of rock mass for safe blasting at critical and sensitive structures.
- Keeping in view the superiority of Electronic Detonators over Pyrotechnic Detonators, Indian mines should switch over to the former as far as possible for not only to address safety issues but also to improve productivity.

Coal and Mineral Processing and Value Addition

- Judicious end-use of low volatile coking coal across the coalfields should be promoted and put into rigorous practice by three-product cleaning. End-products would be clean coal for iron & steel industry, middling as power plant coal and finally rejects as feedstock to fluidized bed combustors in stand-alone mode or in co-firing mode with bio-mass. The Government should formulate a policy in this direction and direct coking coal producers to implement this policy in a defined timeframe.
- The option of utilizing coal ash in opencast mines can produce a quantum jump for enhancing its bulk utilization from meagre 5.85% by the mining sector. Also, the scope of use of bottom ash-plastic mixture as stowing material in underground coal mines should be further explored.
- Backfilling with mass production technology in non-coal mines using mill tailing pastes with fly ash should undergo extensive trials in mines.
- R&D and field trials should be undertaken to extract various value-added products from fly ash such as alumina (for metallurgical application and of chemical grade), impure quartz (for glass applications), calcium silicate (for insulating boards, fire retardants and chemicals) and iron hydroxide (for red oxide and pigment) and rare earth elements.

Oil and Gas

- Field trials of Underground Coal Gasification (UCG) should be undertaken as one of the top priority areas to tap energy from un-mineable or difficult to mine coal seams. As it is not an economically established technology and has not been tried in India it is recommended to take up this technology in a virgin mining area and establish both its technical and economic viability.
- Extraction and utilization of Coalbed Methane (CBM), Coal Mine Methane (CMM), Abandoned Mine Methane (AMM) and Ventilation Air Methane (VAM) should be taken up in suitable economically viable areas in order to harness energy from this relatively

clean energy resource and also to mitigate methane emission into the atmosphere.

- In the areas of oil and natural gas most profound technical developments have been in the field of reservoir imaging (3D seismic) drilling and completions, including horizontal drilling, multi laterals and hydraulic fracturing and enhanced oil recovery techniques. These technologies need to be increasingly adopted by the coal mining industry specially in the areas of UCG, CBM, CMM etc.
- In oil sector, for arresting production decline in mature fields induction of new technologies with bold investment decisions are required.