

Safety aspects in Heavy Earth Moving Machinery (HEMM) to meet technology trends in Open Cast Mining applications



By

K. Vijayakumar

Director of Mines Safety(Mech)

DGMS,SZ,Bengaluru.

With increasing dependence on opencast mines for all the production demands in the Coal and Metalliferous sector, there has been a steep rise in the population of HEMMs and heavy/light vehicles in mines, distributed between both departmental and contractual components. The recent statistics on alarming rise in cases of incidences/ accidents in opencast mines singularly point to the basic cause as intricately connected to such deployment in mines. Though, several statutory provisions have already been made under the Coal Mines Regulation 2017 and the Metalliferous Mines Regulations, 1961, and various statutory permissions issued thereunder apart from DGMS Circulars having been issued from time to time, the issue of their safe operations with particular reference to provisioning and satisfactory operation of various safety features, continues to be a major cause of concern to all. An effort is made to assess and address the concerning issues in this presentation.

Heavy mechanisation of Open Cast Mines has its own demerits like increase in number of fatal accidents and serious accidents during both operation and maintenance activities. Efforts were made by International standardisation bodies and National standardisation bodies to stipulate minimum safety aspects that are to be provided in Heavy Earth Moving Machineries.

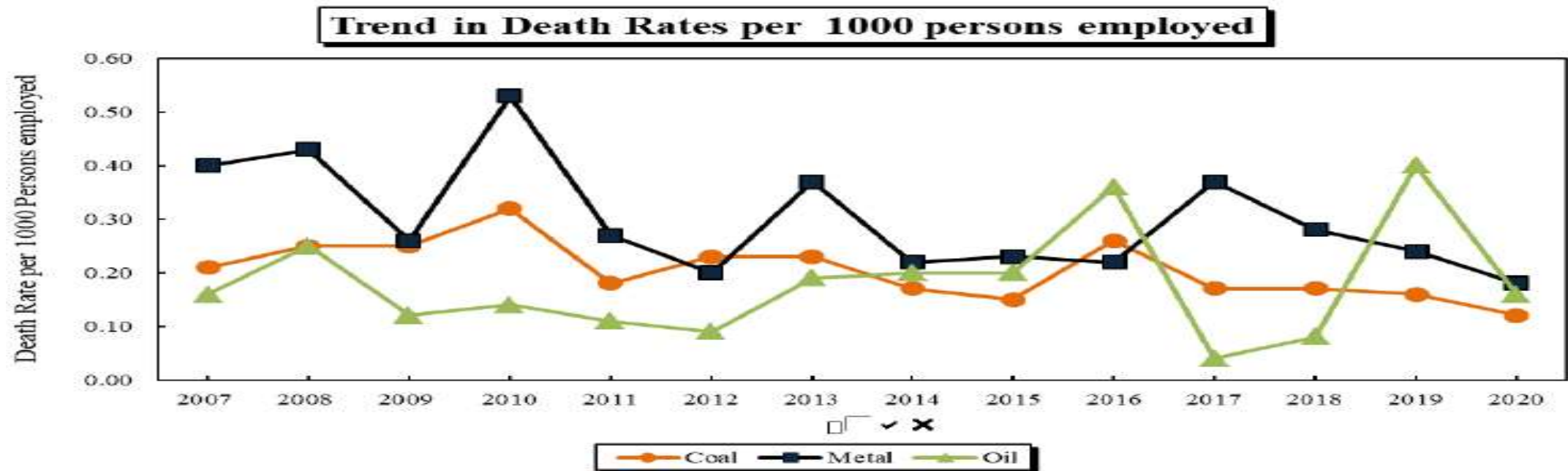
In order to bring down the fatal accidents and serious injuries arising during men-machine interaction and conflicts, the Indian mining regulatory body, Directorate General of Mines Safety (DGMS) mandated many safety aspects that are to be installed in the HEMM from time to time.

The main objective of this presentation is to discuss safety aspects and to look beyond mere provision of the safety aspects in HEMM to integrate them with machine performance and other parameters in line with emerging trends so as to provide an integrated conceptual approach in overall safety of HEMM with the aim to trigger downward trend the decade long stagnated death rate involving HEMM. Further, scope of the presentation is as follows:

(1) Only HEMM as defined in Coal Mines Regulations 2017 (CMR 2017)[2] as “machinery used in opencast mines for digging, drilling (excluding hand held drills and drill machines capable of drilling hole of a diameter up to 50 mm), dredging, hydraulicking, ripping, dozing, grading, excavating, loading or transporting minerals or overburden ” are considered.

(2) Data released by Directorate General of Mines Safety (DGMS) under Ministry of Labour and employment, Government of India in their Standard Notes were relied upon.

The Present Scenario – Death Rates: Graph at Figure-1 below indicates the trend in death rates per thousand persons employed in Coal, Metalliferous and Oil Mines. It clearly indicates that the trends almost hover around straight lines for almost thirteen years in a row.



Graph at Figure-2 indicates death and serious injuries rates in Coal Mines.

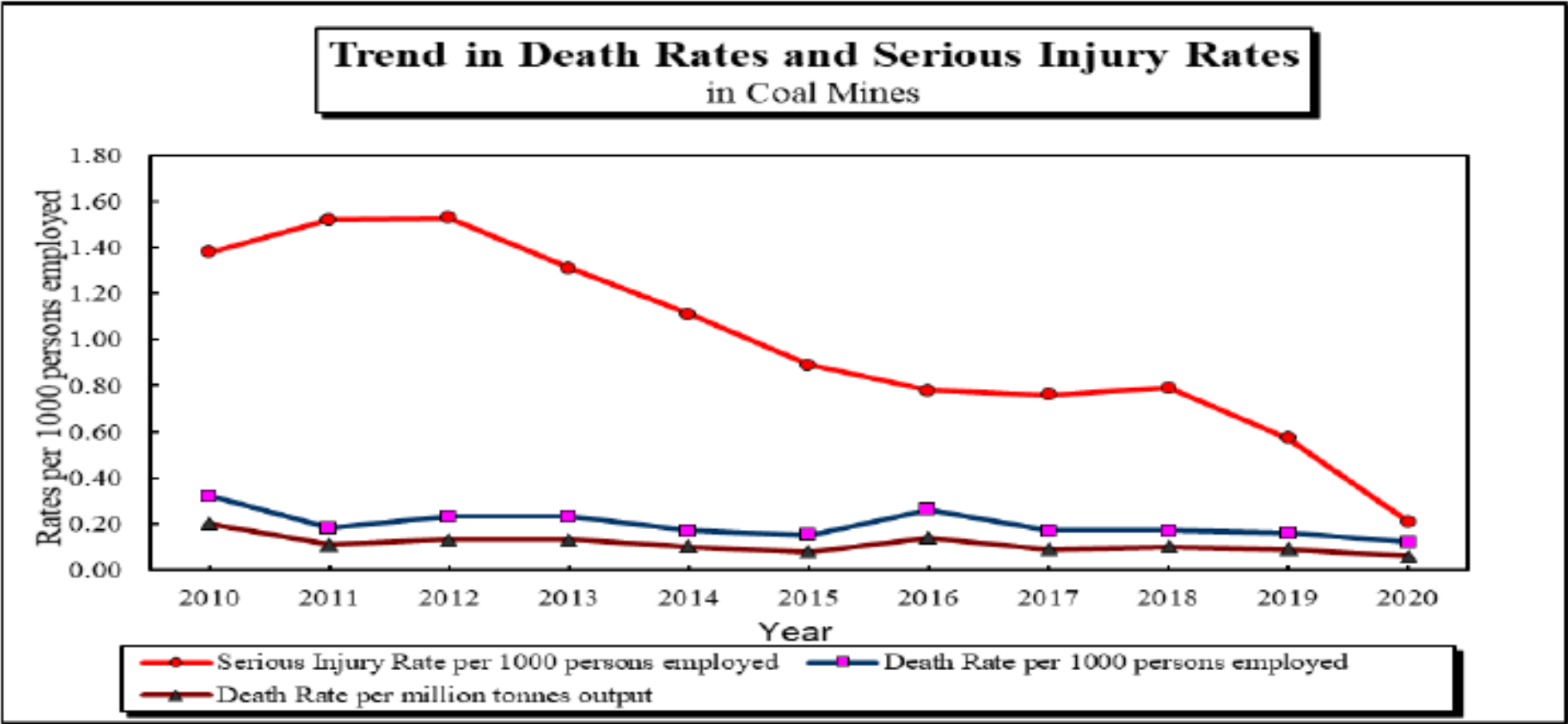


Figure-2

Graph at Figure-3 indicates death and serious injury rates in Metalliferous Mines.

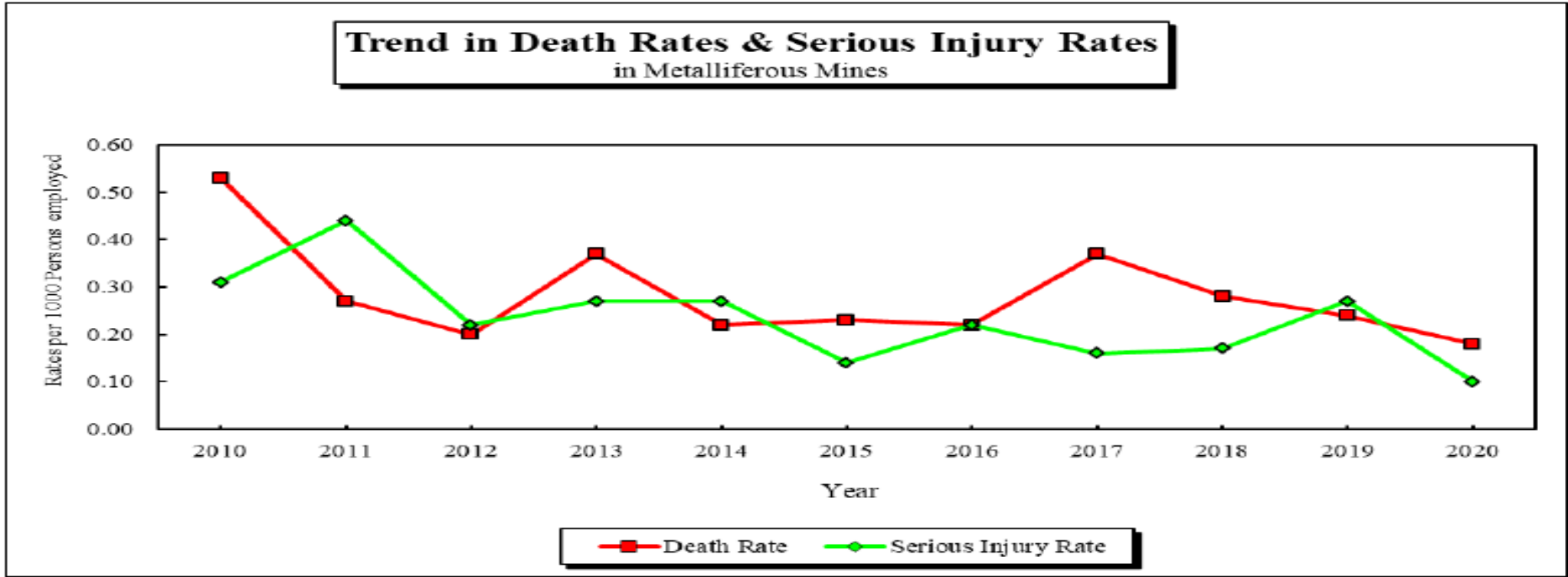


Figure-3

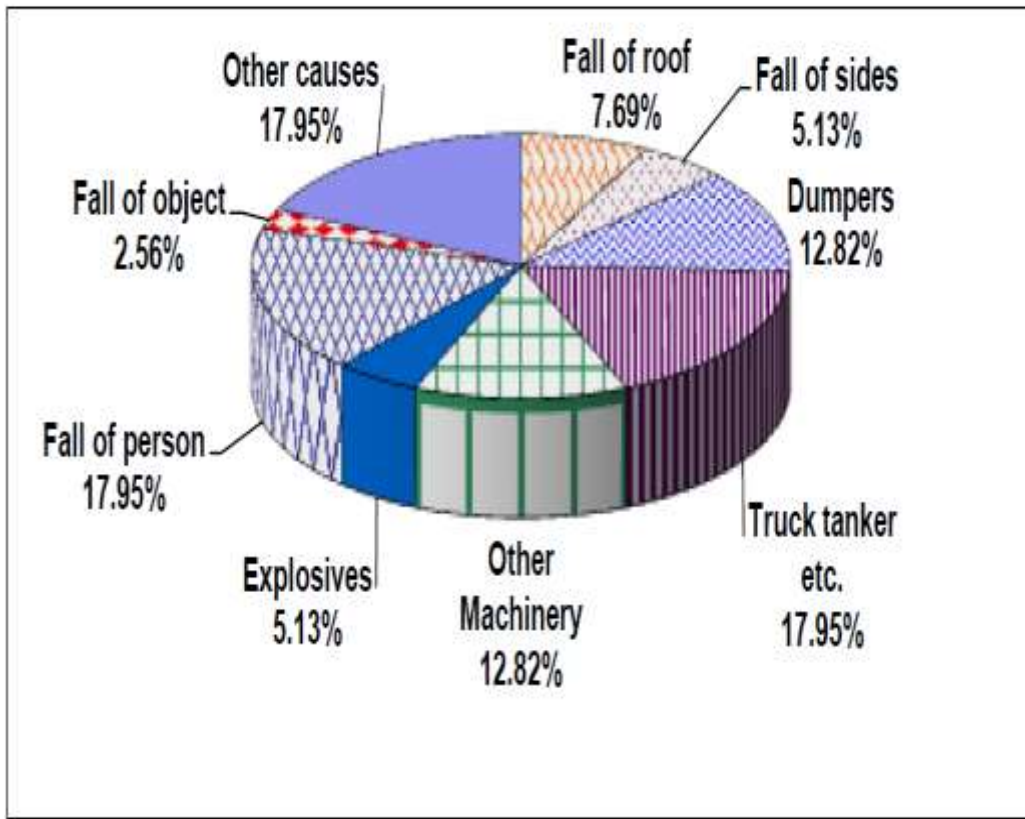


Figure – 4 indicates the Cause wise distribution of fatal accidents in Coal Mines in the year 2020.

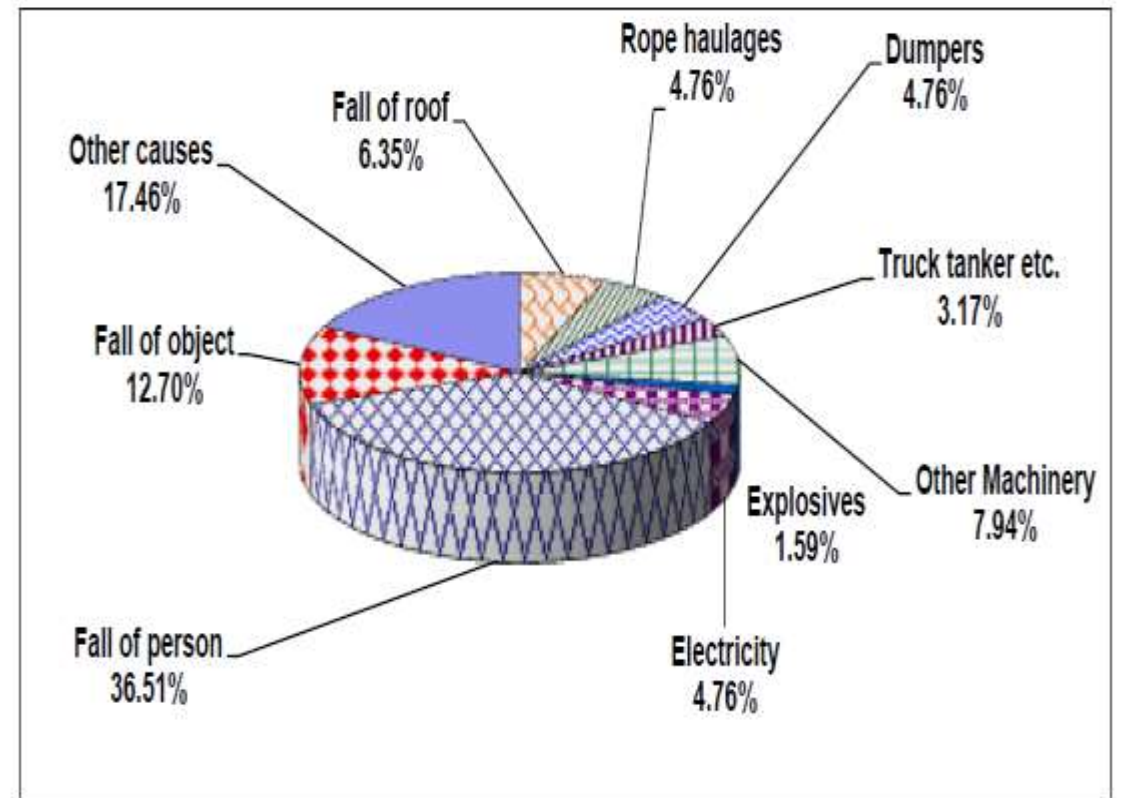


Figure-5 indicates the cause wise distribution of serious accidents in Coal Mines in the year 2020

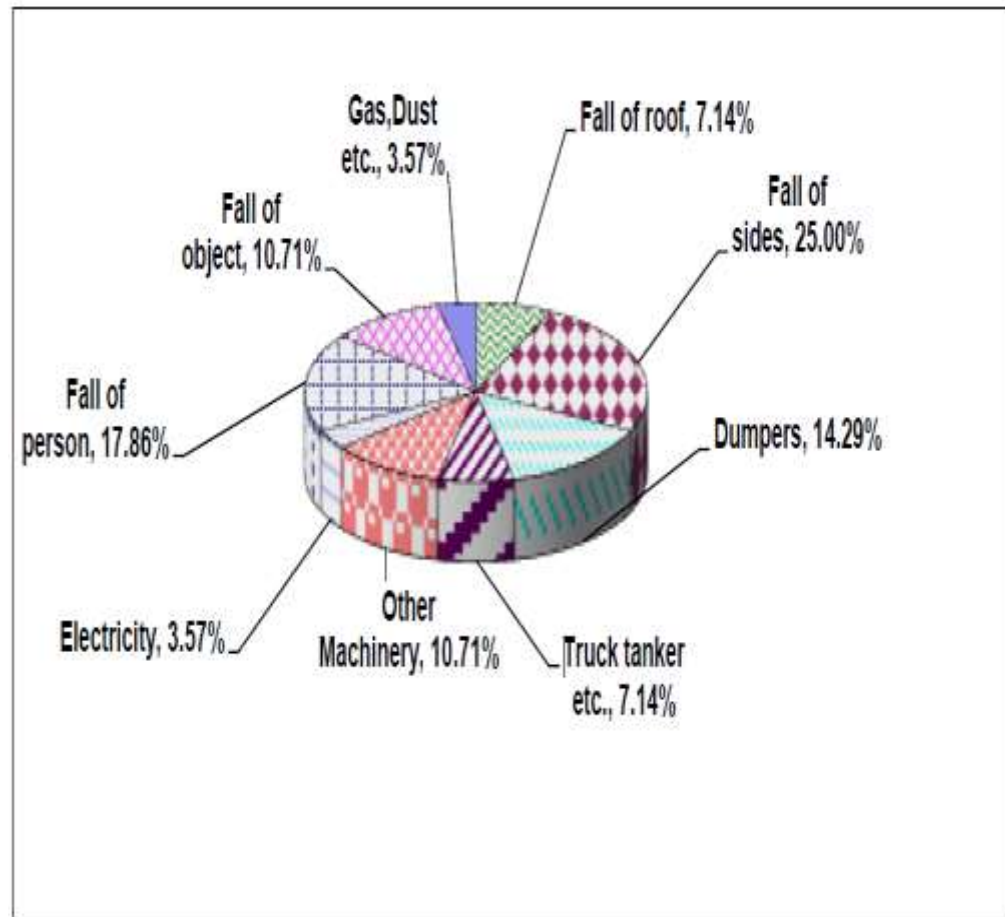


Figure – 6 indicates the Cause wise distribution of fatal accidents in Non-Coal Mines in the year 2020

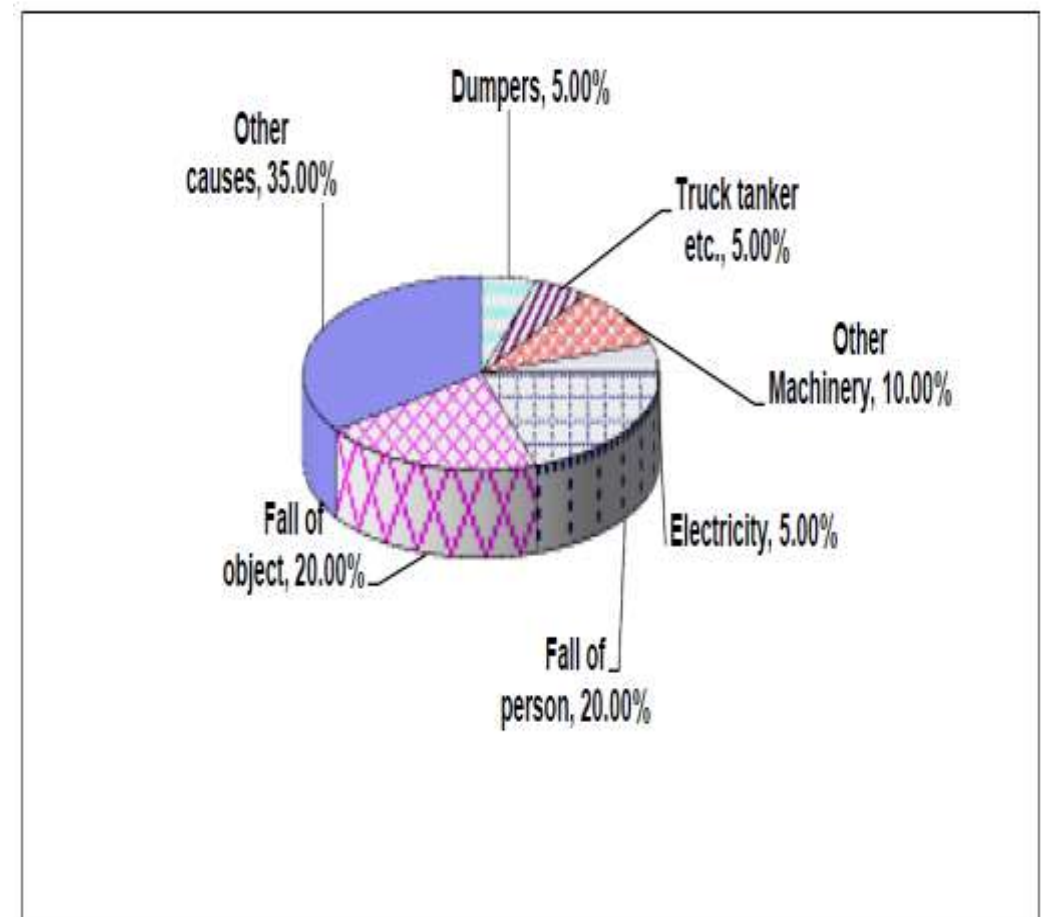


Figure – 7 indicates the cause wise distribution of serious accidents in Non-Coal Mines in the year 2020

Dumpers and Tippers are the major contributing factor in the accidents. However, other HEMM machinery like Dozers, Graders, Drills, Excavators etc. were clubbed with other machineries in the data released by DGMS. It is evident from the above that the HEMM have lion's share in the accidents. These accidents occurred during operation of the HEMM and during maintenance activities on them.

Factors affecting Safety in HEMM; The following aspects are required for safety in HEMM during both operation and maintenance activities:

(a) Protection to Operator. (E.g. Fall Over Protection system, Roll Over Protection, Tip over protection etc), (b) Operator's Visibility for Clear line of sight, (c) Brake system, (d) Steering system, (e) Hydraulic and or Pneumatic Systems, (f) Pressure lines, (g) Warning Devices to warn persons in the vicinity, (h) Vibration, (i) Noise, (j) Lights (Head / Tail / Reversing), (k) Protection from unintended movement of the Machine, (l) Fire Protection system, (n) Protection from moving parts, Sharp edges and hot objects, (o) Access System for Operator Station, Maintenance activities, Exit etc., (p) Displays, Operator Controls and operator sitting posture with due attention to ergonomics and operator fatigue, (q) Track / Tyres and Rims, (r) Cable reeling Drums, (s) Stability of the Machine during all intended operating conditions, (t) Towing and Retrieval of the Machine in case of Emergency and under unforeseen circumstances, (u) Emergency Cut-off system, (v) communication system for operators, (w) operators fatigue monitoring system (x) any other statutory requirements mandated by appropriate regulatory bodies.

Model framework by an integrated approach;

Most of the Fatal Accident inquiry into the accidents involving HEMM revealed that main reasons for the accidents are non-provision of one or more of the safety aspects, inadequate maintenance of the safety aspects to keep them in working order, Operators turning off or damaging the safety aspects due to multiple or nuisance warning or apprehension that his actions are being recorded, failure of the safety aspects due to inadequate design, delayed application or response of the aspect and substandard equipment. DGMS issued a technical Circular in the year 2020[6] to address some of these issues. Twelfth National safety conference on Safety in Mines [7] recommended use of IT in HEMM.

Technology trends;

Systems of the HEMM and a logical and timely corrective actions are to be initiated with or without the involvement of the Operator and to have external communication through IoT. The HEMM with defective critical safety aspects need to be immobilised by the Safety Control System. Such immobilisations are to be provided with emergency manual override after authorisation from appropriate person. Every critical parameters affecting the safety aspects is to be automatically communicated to the persons at the higher hierarchy for intervention and timely corrective action on real-time basis. This system should not work in silos but must be part of Integrated Mine management system using IoT and other recent technologies that are being used in Industry. To enhance safety, Behaviour Based Safety (BBS) system of persons employed in the mine need to be established.

Conclusion

Automatization of most of the operations of Machinery in particular that of HEMM is need of the changing time. Already few countries had started transportation of minerals in opencast mine by Autonomous vehicle movement. Moving towards adopting the suitably modified concept of Industry by taking advantages of Internet of Things (IoT), Cloud computing, Artificial Intelligence and Machine learning (AI & ML), Edge computing, Cyber security and Digital Twins will generate lot of data that form a huge repository for the mining industry which will pave way for better mine planning, improvised design of mining machinery, lessor man-machine conflicts, lessor downtime of machinery including HEMM by suitably modifying maintenance and operational practices .

References;

- 1). The Mines Act 1952.
- 2). The Coal Mines Regulations 2017.
- 3). The Metalliferous Mines Regulations 1961.
- 4). Yearly Standard Notes published by DGMS.
- 5). Government of India Gazette Notification G.S.R. 987(E) dated 01.10.2018 published in The Gazette of India Extraordinary Part II- section 3- sub-section (i) No. 705 dated 04.10.2018.
- 6). DGMS Technical Circular 06 of 2020 dated 27.02.2020.
- 7). *Recommendations of 12th National Conference on Safety in Mines* held on 28th & 29th January, 2020, at New Delhi.

SAVE EARTH
SAVE LIFE



