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RESEARCH & DEVELOPMENT

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GOVERNMENT OF INDIA
MINISTRY OF MINES
INDIAN BUREAU OF MINES

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5 Research & Development

The Science and Technology (S&T) programmes of the Ministry of Mines, Government of India, cover the disciplines of Geology, Exploration, Mining, Bioleaching, Beneficiation, Rock Mechanics, Ground Control and Non-ferrous Metallurgy and environmental issues related to mining and metallurgy. During 2012-13, two meetings were held by Project Evaluation and Review Committee (PERC). Based on Committee's scrutiny report, Standing Scientific Advisory Group (SSAG) considered and recommended Grant-in-Aid under S & T programme of the Ministry of Mines. The SSAG approved nine project proposals in the meeting held on 1st December 2012.

The highlights of work carried out during 2011-12 by IBM along with industries and National Institute of Rock Mechanics relating to mineral beneficiation and mining & environment are given below:

1. BENEFICIATION

1.1 Iron Ore

Beneficiation studies on iron ore sample from SBK Mines, Bellary for M/s Swastik Steels (Hospet) Private Limited (IBM): An iron ore sample assaying 50.30% Fe(T), 0.53% FeO, 12.85% SiO_2, 8.03% Al_2O_3, 6.02% LOI was received from SBK Mines, Bellary, Karnataka sent by M/s Swastik Steel (P) Ltd. at RODL, IBM, Bengaluru. The party desired a process where iron concentrate produced assayed +62% Fe(T). By adopting various techniques viz, crushing, screening, tabling and magnetic separation, an iron ore concentrate assaying 63.71% Fe(T), 2.58% SiO_2, 2.31% Al_2O_3 with recovery of 61.1% Fe(T)(Wt% yield of 48.6) could be obtained. The concentrate may find application in iron industry.

Order of Magnitude equipment sizing for sub-grade Iron Ore beneficiation Project from Sandur-Hospet Area, Bellary distt. Karnataka for M/s V.S. Lad & Sons (Anil), Sandur (IBM): M/s V.S. Lad and Sons (Anil), Bengaluru and RODL, IBM, Bengaluru mutually agreed (1) To prepare a material – metallurgical balance flow sheet producing (a) High grade +65% Fe concentrate (Conc. 1), (b) Medium grade +62% Fe conc. (Conc.II) (c) Sub-grade +50% Fe concentrate (Conc. III) based on earlier test work carried out in RODL, IBM, Bengaluru on sub-grade iron ores of the party from Hospet – Sandur area, Bellary distt. Karnataka vide IBM/OD/BNG/R.I. Nos. 564, 568, 645 & 646. The process should consume minimum water per tonne of feed, minimum land requirement and generate low iron, less quantum tails per tonne of feed (2) size the equipment for designated throughput using normal order of magnitude method and catalogues supplied by the party. Compare the size recommended by vendors and offer logical comments.

100 tph and 150 tph plant equipment were sized for 80% availability. The 100 tph and 150 tph plants are scheduled to yield 62% and 1 million tonne concentrate per year respectively with $0.5m^3$/t water, 25 Kwh/t power, 0.8kg/t steel, 0.06kg/t flocculent, $5x10^{-5}$ m^2/t screen and filter cloth at peak operating load. The minimal area required for the plant is 15 acres. The minimum manpower required is 60.

The energy cost reduced by about 2 Kwh/t, if phase II conc., I and II grinding and dewatering to pellet plant requirements is not considered.

Upgradation of a Low grade Iron Ore from Bellary Hospet, Karnataka for M/s V.S. Lad and Sons (Anil), Sandur (IBM): A low grade iron ore sample was received from M/s V.S. Lad and Sons (Anil), Sandur, Hospet, Bellary distt., Karnataka at RODL, Bengaluru. The sample assayed 56.16% Fe (T), 9.10% SiO_2, 4.29% Al_2O_3, 5.07% LOI. By adopting gravity operation and magnetic separation, a composite concentrate assaying 64.22% Fe (T), 3.43% SiO_2, 1.80% Al_2O_3, 2.58% LOI with 64.3% Fe (T) recovery (wt% yield 57.3) was obtained. The concentrate meets the specification stipulated by the party.

Upgradation of dumped Iron Ore from GMIL, Bengaluru (IBM) **:** An Iron Ore sample from GMIL dumps was sent by M/s Greentex Mining Industries Ltd. Bengaluru for bench scale beneficiation studies at RODL, IBM, Bengaluru; with an objective to upgrade the sample for Iron

content with maximum possible recovery and reducing the gangue contents (SiO_2 + Al_2O_3).

The as received sample assayed 42.65% Fe (T), 10.65% SiO_2, 13.72% Al_2O_3, 11.77% LOI. Various beneficiation techniques like washing and screening, gravity separation, dry and wet magnetic separation were adopted for upgradation of this dump ore. It was observed that an usable iron concentrate with +61% Fe content and low value of SiO_2 + Al_2O_3 content could be obtained both by gravity as well as low intensity magnetic separation. However, the iron recovery was low from 25 to 30%.

Upgradation of Iron Ore sample from M/s P.S.L. Holding Pvt. Ltd (IBM): An iron ore sample collected by RCOM, Ajmer from M/s P.S.L. Holding Pvt. Ltd, from Thakuro Ki Dhani, Jaipur, Rajasthan assayed 50.25% Fe(T), 11.07% FeO, 62.14% Fe_2O_3, 2.26% Al_2O_3 and 7.98% SiO_2. The object of the investigation was to find the bulk density and amenability test of the sample so as to produce marketable grade iron concentrate.

An iron ore concentrate assaying 67.51% Fe(T), 0.92% Al_2O_3 and 0.40% SiO_2 with 89.1% Fe recovery (Wt% yield 65.3%) could be achieved by subjecting the sample to wet low intensity magnetic separation followed by gravity separation at minus 100 mesh size. The bulk density of the sample was found to be 2.53 tonnes per meter cube. The beneficiation studies indicate that sample is amenable to beneficiation.

Order of Magnitude Equipment sizing for Sub-grade Iron Ore beneficiation project for M/s Swastik Steel Hospet Private Limited, Hospet (IBM) : M/s Swastik Steel Hospet Private Limited, Hospet (SSPL) requested RODL, IBM, Bengaluru (1) To prepare a material/metallurgical balance flow sheet producing either/and +62% Fe powdery concentrate suitable for pelletisation and /or -20 + 5mm chips +58% Fe concentrate for sponge industry if it meets Tumbler and Abrasion index values based on earlier test work carried out in RODL, IBM, Bengaluru on sub grade iron ores of the party from MML dumps, Sandur, Bellary district, Karnataka. The process should consume minimum water/tonne of feed, minimum land requirement and generate low iron, less quantum tails/tonne of feed. (2) Size the equipment for designated throughput using normal order of magnitude method and catalogues supplied by the party.

The detailed study was carried out. The 250 tph plant is scheduled to yield 1 million tpy concentrates (0.6 million tpy sponge grade concentrate and 0.4 million tpy pellet grade) 0.5m^3/t water, 20 KW.hr/t power is consumed. Enhancement of capacity by 20% could reduce energy by 2 KW.hr/t only.

There is possibility of utilising a part of tails in other industries like cement. Detailed feasibility and design project report preparation followed by design engineering is recommended. There is scope for reducing the cost as some of the drives and machines are over designed.

Upgradation of a sub-grade iron ore fines from Chitradurga, Karnataka for M/s Gem Laboratories Pvt. Ltd, Bengaluru (IBM): A sub-grade iron ore sample from Chitradurga Karnataka sent by M/s Gem Laboratories Pvt. Ltd., Bangaluru assayed 56.74% Fe, 6.97% SiO_2, 5.97% Al_2O_3, 0.38% TiO_2, 0.17% Alkali, 0.07% P_2O_5 and 5.40% LOI. The sample was sent with a view to see the amenability of the samples to sizing, gravity and magnetic concentration.

Both generic conventional process and the non-conventional no grind process consisting of screening, dry rare earth high force high intensity magnetic separation of screen over size grinding of non-magneic and screen undersize fractions to -48 mesh followed by desliming and tabling yielded a composite concentrate assaying 64.54% Fe, 2.21% SiO_2, 2.71% Al_2O_3, 0.35% TiO_2 and 3.17% LOI with 55.2% Fe recovery (wt% yield 49.1%).

This concentrate meets the party's specification required for pellet grade. Detailed continuous pilot scale tests are recommended for conceptual design data and process improvement.

***Magnetic separation studies on Iron ore sample from beneficiation plant of BMM ISPAT Ltd (IBM)*:** Two iron ore samples (feed to HGMS and HGMS matrix choked material) from beneficiation plant of BMM Ispat Ltd was sent at RODL, Bengaluru by BMM, Ispat Ltd. with an objective:

i) To carry out limited magnetic separation test to optimise the grade and recovery of iron without getting trapped inside the magnetic separator and choking the machine, thus reducing the machine capacity,

ii) To observe whether the introduction of MIMS would lower the load on HGMS and avoid choking of matrix element. After conducting tests, it was concluded that coarse material may be used in HGMS to avoid choking as finer matrix at 3600 gauss choked the machine. Hence, introducing MIMS before HGMS may not solve choking problem. It was also observed that choking in the machine is due to plus 65 mesh material that is not screened. After screening the feed to HGMS, the iron content could be increased from 53.79% Fe (T) to 59.56% Fe(T) with 73.8% Fe(T) recovery (wt% yield 66.9). The grade and recovery of iron being maximum and machine not getting choked. It is inferred teething problem can be solved by the introduction of screen size of 65 mesh (212 microns) before feeding to HGMS alternately.

BMQ exploratory sample from Mincheri Forest, Vuravakonda Mandal for M/s Loh Processors & Traders, Bellary (IBM): A BMQ exploratory sample from Mincheri Forest, Vuravakonda Mandal, Rayadurga Taluk, Ananthpur district, A.P. sent by Loha Processors & Traders, Bellary assayed 35.85% Fe (T), 6.58% FeO, 40.58% SiO_2, 1.45% Al_2O_3 and 2.93% LOI. The objective of the investigation was to upgrade the iron content as much as possible by gravity separation. After grinding the as received sample to -48 mesh, and subjecting it to gravity separation, a iron concentrate assaying 65.58% Fe(T), 5.45% SiO_2, 0.28% Al_2O_3 with 59.6% Fe(T) recovery (wt% yield 32.1) could be obtained. The exploratory sample may be taken for full bench scale investigation, so that it finds industrial utility.

An Iron Ore sample from M/s P.S.L. Holding Private Ltd, Thakhuro Ke Dhani, Jaipur Distt., Rajasthan (IBM): An iron ore sample from M/s P.S.L. Holding Pvt. Ltd., Thakhuro Ke Dhani, Jaipur distt.,Rajasthan was sent by RCOM, IBM, Ajmer and RODL, Ajmer to study the amenability of the sample, so as to obtain iron concentrate by reducing phosphorous content to the desired level. The sample as received assayed 50.25% Fe(T), 11.07% FeO, 62.14% Fe_2O_3, 2.26% Al_2O_3, 7.98% SiO_2,1.58% P and 0.05% S. Wet low intensity magnetic separation followed by gravity concentrate and refining the gravity concentrate by wet low intensity magnetic separation at -100 mesh yielded a composite magnetic concentrate assaying 69.91% Fe(T), 1.07% SiO_2, 0.68% Al_2O_3, 0.13% P with 75.9% Fe(T) recovery (wt% yield 54.1). This concentrate meets the specification required for the steel industry. Further, when non-magnetic products is subjected to flotation, a phosphate concentrate assaying 18.46% P_2O_5, 2.58% Fe(T), 1.13% SiO_2 and 0.68% Al_2O_3 with a P_2O_5 recovery of 73.4% (wt% yield 27.7) could be obtained. This phosphate concentrate is found to be suitable for direct application to soil and for pig iron industry.

In addition, above 15% by weight of mica (-100 + 200 mesh) can also be recovered from the non-magnetic tails sample. Thus, the phosphate concentrate and mica as side products recovered from non-magnetic tails may be conserved and utilised for industrial application.

Low grade iron ore samples and dumped fines were collected from Gua and Meghtaburu mines of SAIL (NML) **:**The dumped fines samples collected from Gua Mines analysed 59.86% Fe/4.19% Al_2O_3/4.05% SiO_2. The flowsheet developed indicates that obtaining a sinter fines product of 63% Fe with 39% yield and a pellet fines of 65% Fe with 33% yield is possible by combination of jigging, spiraling and magnetic separation.

Studies were completed for processing of BHQ sample fromMeghtaburu mines (NML)**:** The results indicated that a product with +63% Fe and 5.8% SiO_2 is obtainable from BHQ through WHIMS and flotation.

1.2 Chromite

Concentration of chromite ores by magnetic separation(NML**):** These chromite ores are associated with silicate impurities (chert, serpentine, chlorite) and iron bearing mineral impurities (limonite, goethite, hematite). Gravity based separation techniques are dominantly used for concentration of low grade chromite ores. In the present study, the effect of magnetic field intensities using high intensity magnetic separator (WHIMS) was studied on concentration of different types of chromite samples. It was obseved that natural (raw) ore samples showed improvement in %Cr_2O_3 content of the magnetic product with lowering iron and silica contents.

1.3 Clay

Study to develop a process for recovering iron values from the fine grained manganiferrous clay sample from Goa region (NML): The clay sample showed Fe-45% with 7% Mn in it. The manganiferous clay is an ore of very fine size, dominated by the particles of grain sizes smaller than 25 micron, and hence are termed as clay on textural basis. The ore is technically a "manganiferous hematitic iron ore fines". Preliminary mineralogical study showed that the ore consists of

magnetite, dense martite, microplaty hematite, pyrolusite, psilomelane and clay. The manganiferous minerals (pyrolusite, psilomelane) are predominant at finer grain-size. Detailed work is in progress.

1.4 Laterite

JNARDDC, Nagpur, an autonomous body of Ministry of Mines provides major R&D support system for the emerging modern aluminium industry in India one of the major Science & Technology ongoing Projects sponsored by Ministry of Mines includes upgradation and utilisation of laterite of East & West Coast deposits.

1.5 Limestone

***Upgradation of Low grade Limestone sample (IBM)*:** A limestone sample assaying 36.65% CaO, 2.23% MgO, 20.66% SiO_2, 1.69% Fe_2O_3, 4.34% Al_2O_3, 32.12% LOI was sent by M/s Prism Cement (Limestone Mines) Ltd. Satna., M.P. at Modern Mineral Processing Laboratory and Pilot Plant, IBM, Nagpur. The objective of the investigation was to upgrade the CaO values by dry, wet or combination of dry and wet process. However, dry scrubbing following by wet screening at -12 mm could not yield the desired concentrate.

By adopting flotation route a concentrate assaying 45.03% CaO, 2.12% MgO, 1.06% Fe_2O_3, 9.86% SiO_2, 2.49% Al_2O_3 and 38.1% LOI with 90.1% CaO recovery (wt% yield 73.4) could be obtained. The concentrate obtained meets the requirement of the party and may find industrial utility.

Production of a Limestone concentrate for cement industry on a sample sent by M/s Birla Cement Works, Chittorgarh, Rajasthan (IBM): A limestone sample was received from M/s Birla Cement Works, Chittorgarh, Rajasthan at RODL, Ajmer. The as received sample assayed 41.42% CaO, 1.80% MgO, 18.04% SiO_2, 1.39% Fe_2O_3, 32.95% LOI with 73.93% total Carbonates. Flotation route was adopted to achieve the desired concentrate. Flotation at 94% -200 mesh grind produced a limestone concentrate assaying 47.24% CaO, 9.68% SiO_2, 37.98% LOI, 84.36% $CaCO_3$ (TC) with 83.1% CaO recovery (wt% yield 73.6). The concentrate obtained meets the requirement of the party and may find industrial utility.

***Beneficiation studies on two Limestone samples namely Dolomitic and Silicious to obtain a suitable concentrate for utilization in Cement Industry from Bhagabhalag Limestone Mines of Jaypee Himachal Cement Plant* (IBM):**The Regional Controller of Mines, IBM, Dehradun sent two limestone samples from Bhagabhalag Limestone Mines of Jaypee Himachal Cement Plant to RODL, IBM, Ajmer with an objective to obtain a suitable limestone concentrate for utilisation in cement industry.

The first sample labeled as siliceous Limestone assayed 35.12% CaO, 0.91% MgO , 26.75% SiO_2, 2.11% Fe_2O_3, 3.0% Al_2O_3 and 29.85% LOI. By adopting flotation technique, a second cleaner concentrate assaying 45.60% CaO, 12.71% SiO_2 and 36.84% LOI with a CaO recovery of 82.4% (wt% yield 65.5) could be obtained. This concentrate meets the requirement of cement industry.

The other sample labeled as dolomitic Limestone assayed 30.12% CaO, 10.37% MgO, 19.90% SiO_2,1.13% Fe_2O_3, 0.93% Al_2O_3 and 35.90% LOI. By adopting flotation technique, a concentrate assaying 34.17% CaO, 10.55% MgO, 9.74% SiO_2 and 40.64% LOI with 84.9% CaO recovery (wt% yield 73.9) could be obtained. This concentrate is not suitable for cement industry.

However, this above concentrate may find utilisation in cement making after blending with other high grade concentrate obtained after beneficiation of siliceous limestone sample in the ratio of 40 : 60. The composite limestone concentrate would assay 43.05% CaO, 11.59% SiO_2, 2.83% MgO and 37.81% LOI with a CaO recovery of 80.8% (wt% yield 62.4). This concentrate may find utility in cement industry.

1.6 Rock Phosphate

Upgradation of below threshold value of Rock Phosphate sample from M/s MECL for industrial application (IBM): M/s MECL, Nagpur requested IBM, to explore the possibility of beneficiating the low grade sample from Dhol-ki-Pati block, Tickhi Project, Udaipur, Rajasthan. Accordingly, a team of IBM officers from RODL, Ajmer visited Tickhi Project, Udaipur. The original sample assayed 2.13% P_2O_5, 7.84% CaO, 1.76% MgO, 3.05% Fe_2O_3, 3.47% Al_2O_3, 74.04% SiO_2, 79.47% A.I. and 5.95% LOI.

By adopting flotation route, a phosphate concentrate assaying 15.72% P_2O_5 and 18.99% A.I. with P_2O_5 recovery of 66.6% (Wt% yield 8.8) could be obtained. By subjecting the above concentrate to WHIMS and further leaching the non-mag concentrate with 8% dilute acid, a phosphate concentrate assaying 20.05% P_2O_5, 38.14% CaO, 0.36% MgO, 20.18% SiO_2, 21.58% A.I. with P_2O_5 recovery of 62.8% (Wt% yield 6.5) could be obtained.

The investigation revealed that phosphate sample assaying 2.1% P_2O_5 which is lesser than the threshold value of minerals for implementation (<5% P_2O_5) can be beneficiable up to 18-20% P_2O_5 with P_2O_5 recovery of 63-67% (Wt% yield: 6.5-7.5). The feed to concentrate enrichment ratio is -10. The concentrate may find application in the iron and steel industry which utilizes 15-18% P_2O_5 in the production of high phosphorous pig iron. It can be utilised for the direct application to the soil.

1.7 Silica Sand

***Beneficiation studies on a silica sand sample from Allahabad for M/s Mangalore Minerals (Pvt.) ltd, Mangalore (IBM)*:** A Silica sand sample received from Allahabad from M/s Mangalore Minerals (Pvt.) Ltd, Mangalore assayed 98.48% SiO_2, 0.23%Fe_2O_3, 0.53%Al_2O_3, 0.044%TiO_2, 0.02%K_2O and 0.40% LOI. The objective of the investigation was to develop a suitable process flow sheet to produce a silica sand concentrate in the size range of -30+150 mesh assaying 98.5% (min.) SiO_2, 0.01 to 0.06% Fe_2O_3, < 1% Al_2O_3, < 0.03%TiO_2 and < 0.3% LOI.

Various routes i.e. screening, attrition scrubbing and magnetic separation were adopted to achieve the desired grade and the following composite concentrates could be obtained:

(1) -30+150 mesh composite concentrate assaying 99.41% SiO_2, 0.059% Fe_2O_3, 0.093% Al_2O_3, 0.01% TiO_2 and 0.024 % LOI with wt% yield 93.9 and

(2) Alternative route by grinding the -10+30 mesh sample to all -30 mesh and screening over 150 mesh followed by attrition scrubbing and magnetic separa-tion, a non-magnetic concentrate assaying 99.46% SiO_2, 0.036% Fe_2O_3, 0.090% Al_2O_3 with wt% yield 76.1 was obtained.

The concentrates produced meet the specification of silica sand laid down by the party.

2. MINING

National Institute of Rock Mechanics (NIRM): The National Institute of Rock Mechanics (NIRM) is a premier centre for research in applied and basic rock mechanics locataed at Kolar Gold Fields in Karnataka. It is an ISO 9001 : 2000 certified research Institute. The Institute provides research and consultancy services for improving safety and productivity in the mining and civil engineering sectors. With its rich experience, underpinned with the strength of world class software and laboratory facilities, NIRM plays a vital role in offering technical services in mining, hydroelectric and tunnelling projects, site evaluation for construction of nuclear power plants and underground storage caerns for petroleum sector.

NIRM has been carrying out research work through both government funded and industry-sponsored S&T and consultancy projects. The Institute has been extending its support to the industry in the following areas:

- Metalliferous mines / Hard Rock Mines
- Coal Mines
- Hydroelectric & Tunnelling Projects
- infrastructural and Civil Construction Projects

The brief S&T / R&D activities in respect of few projects are given below:-

- Estimating the recurrence of earthquakes in the Central-Eastern Himalaya and Upper Assam from the distant liquefaction features of the river plains.
- Contemporary depositional environmental investigations of Chorabari Glacier in Rudraprayag District of Garhwal Himalaya.
- Monitoring Indian Shield Seismicity with 10 BBS to understand seismotectonics of the region using V-SAT Connectivity.
- Caveability of roof strata in longwall panels.
- Study on blasting dust management system in an opencast coal mine.
- Assessment of ground water quality in the gold mining areas at KGF and its impact on health (In-house project).

Industry Sponsored Projects: Geological and geo-technical investigations for preparation of DPR for 2 x 350 MW Malshej Ghat PSS, Maharashtra.

- Construction stage engineering geological investigations of underground rock cavern complex for strategic storage of crude oil at Visakhapatnam, AP.

- Construction stage engineering geological mapping of foundation of Rajasthan Atomic Power Project, Rawatbhata, Rajasthan.
- Seismotectonic evaluation and related geological studies in Pudimadaka area in Achuta-puram mandal, Vishakhapatnam, AP.
- Cross-hole seismic tomography at Sainj HEP, Himachal Pradesh.
- Seismic refraction and tomography survey at Bunakha HEP, Bhutan.
- Determination of in-situ stress parameters by hydrofrac method at proposed pressure shaft of Rangit HEP.
- Stability analysis of landslide area of Varunavat Parvat Project Controlled blast design for rock excavation close to structures and green concrete and ground vibration measurement near Unit 7 & 8, Nuclear Plant, RAPP, Kota.
- Technical guidance for rock blasting and monitoring of ground vibration, air overpressure and flyrock during excavation at underground stations from Chinnaswami Stadium to City Railway station (Bengaluru Metro).

3. ENVIRONMENT

Indian Bureau of Mines *(IBM)* : During 2011-12, Mining Reserch Cell of T.M.P. Division, IBM has carried out eight studies, for Environmental Quality Monitoring and six for Ground Vibration due to Blasting in mines. The salient features of the studies are as follows :

Environmental Monitoring at Saniem and Shigao Iron Ore Mines of M/s Fomento Industries (P) Ltd, Goa, for the year 2009-10: The study on environmental quality monitoring at Saniem and Shigao Iron Ore Mines of M/s Fomento Industries (P) Ltd, Goa, has been carried out for all the four seasons for 2009-10 to monitor environmental parameters such as air, water, soil and noise at the mines. The study has indicated that all the environmental parameters monitored are well within the prescribed limits as per MOEF standards. The study thus helped the mine management to develop proper mitigation measures. The final report is submitted to the party.

Blast Vibration Study at Metmangrur Stone Quarry in Umred Tehsil, Nagpur District (Maharashtra) of M/s Shri Praveen Natthalal Thakkar, Mumbai, Mahashtra On the request of M/s Shri Praveen Natthalal Thakkar, a study of Ground Vibrations due to blasting at their Metamangrur Stone Quarry, Umred Tehsil, District Nagpur, Maharashtra, over a lease area 6.80 ha, was carried out to study the impact of blast induced ground vibrations on the nearby structures, human settlement and to suggest control measures to minimise the adverse impact of the same. Under this study, total 7 nos. of blasts at Metamangrur Stone Quarry site were carried out and monitored at 2-3 different points in the area.

In Metamangrur Stone Quarry, the charge weight per delay is less than 25.0 kg. The observed Peak Particle Velocity (PPV) for charge weight of 25.0 kg. for a distance of 2100.0 m is 1.11 mm per second which is well within the safe limit. The structures belonging to the owner which are at a distance of 900 m and 1100 m, the calculated PPV is 3.33 and 2.57 mm per second respectively for a maximum charge per delay of 25.0 kg, which is also well within the safe limit. During the study, it has been found that the frequencies below 8 Hz are 'NIL'. The air over pressure (sound level) is also well within the safe limit. For further minimising the vibration effects and fly rocks due to blasting control measures have been suggested in the report.

Public Interest Litigation Writ No.13/2010 filed by the court on its own motion V/s. The State of Maharashtra and others, regarding presentation of Gadmandir at Ramtek: The Executive Engineer, Construction Division (Special Project), Bungalow No.39/1, Civil Lines, Nagpur-440 001 (Maharashtra), has approached the Indian Bureau of Mines, Nagpur for Public Interest Litigation, filed by the court on its own motion V/s. the State of Maharashtra and others, regarding preservation of Gadmandir at Ramtek and

requested to study the impact of mining specially with reference to blasting on Gadmandir, Ramtek.

Accordingly, IBM observed that Mansar (Underground) Manganese Mines of MOIL is the nearest mine at a distance of 4.0 kms. from Gadmandir (Ramtek) having production of more than 5000 tonnes per month. It was decided by the committee to study the impact of mining specially with reference to blasting and induced ground vibration on Gadmandir (Ramtek) as per the directives of High Court.

To study the effect/impact of mining activity, 15 number of blasts at Mansar Underground Manganese Mines in different faces which are in the direction of Gadmandir-Ramtek monitored and are marked on U/G Plan of Mansar mines showing blasting and monitoring locations. In consultation with the Mines Manager/ Agent of Mansar (U/G) Manganese Mines, total 10 nos. of blast were monitored on surface in the direction of Gadmandir-Ramtek, all the blast readings were taken after a gap of few days so that true picture should come out. Report based on the monitoring observations & conclusion was submitted to Executive Engineer, construction division, Nagpur.

Blast vibration studies at Venkatesh Stone Quarry (2.76 ha) (Khasra No. 416/1 & 416/2) at Pachgaon in Tahsil:-Umred, Distt:- Nagpur (Maharashtra) of M/s Venkatesh Minerals (Owner-Shri Shayam Lalaram Jaiswal) : The study was carried out to record the impact of blast induced ground vibrations on the nearby structures, human settlement and to suggest control measures to minimize the adverse impact of the same. During this study, total 10 nos. of blasts at Venkatesh Stone Quarry site were carried out and monitored at 2-3 different sites in the area.

The calculated peak particle velocity for the charge weight of 25.0 kg, for a distance of 3000 m is 3.12 mm/sec, which is well within the safe limit. The ground vibration intensity estimated for even maximum charge weight per delay of 50 kg which is presently not in practice, is also well within the safe limit.

It is suggested that the present blasting practice may be continued, as there is no damage to nearby structures by this charge weight of 25.0 kg per delay and even for calculated charge weight of 50 kg.

Blast vibration studies at Pachgaon Stone Quarry (2.40 ha) (Khasra No. 451/2 & 451/4) in Umred tahsil, Distt:- Nagpur (Maharashtra) of M/s Sidheshwar Infrastructure India Limited (Director-Shri Shayam Lalaram Jaiswal) : The Study was carried out to know the impact of blast induced ground vibrations on the nearby structures, human settlement and to suggest control measures to minimise the adverse impact of the same. During this study, total 11 nos. of blasts at Pachgaon Stone Quarry site were carried out and monitored at 2-3 different sites in the area.

The monitoring data revealed that the structures like Quarry Office/Stores situated at a distance of 60 m from blasting sites are not within the zone of safe limit i.e. 50 mm /sec. Even for the maximum charge weight per delay of 15 kg, the calculated ppv at this structure arrived as 53.9 mm/sec. These structures have to be shifted to the safer distance i. e. beyond 60 m in accordance with the prevailing blasting pattern, considering higher safety factor or to bring these structures under the zone of safe limit, the charge per delay should not be exceeded 12.9 kg as calculated. During the study, it has been found that the frequencies below 8 Hazare 'NIL'. For further minimising the vibration effects and fly rocks blasting control measures have been suggested in the report submitted to the party.

Blast vibration studies at Shri Warad Stone Quarry (1.33 ha) Khasra No. 77/3 M/s Shri Warad Industries, Near Tip Top Convent, Survey Nagar,District:- Nagpur – (Maharashtra) (Owner : Shri Sachin S. Pitale) : The study was carried out to know the impact of blast induced ground vibrations on the nearby structures, human settlement and to suggest control measures to minimise the adverse impact of the same. During this study, total 12 nos. of blasts at Shrivarad Stone Quarry site were carried out and monitored at 2-3 different places in the quarry area.

It has been observed that during blasting operation, normally the charge weight per delay is kept less than 35.0 kg. Considering factor of

safety, the vibration limit for nearest structure (Not belonging to owner) situated at Surgaon (Undri) village is 10 mm/sec at a frequency 8-25 Hz. Even with the charge weight of 35 kg per delay, at a distance of 1200 m is calculated to be 3.19 mm / sec, which is well within the safe limit in view of DGMS Standards.

The structures belonging to the owner which are at a distance of 250 m, the calculated Peak Particle Velocity is 33.7mm/sec for a maximum charge per delay of 25.0 kg. which is well within the safe limit when dominant excitation frequency which is observed during the study is >100%.

For further minimising the vibration effects and fly rocks due to blasting, some control measures have been suggested in the report.

Report on impact of blast induced ground vibrations on Chittorgarh Fort due to working of limestone and China clay/red ochre mines situated within radius of 10 km: As per the direction, Honourable High Court Rajasthan while disposing D. B. Civil Writ Petition (P.I.L.) No.6591/ 2011 filed by Bhanwar Singh & others v/s Union of India and others, pertaining to the mining activities in the surrounding area of Chittorgarh Fort requesting a ban on the Mining activities in the nearby area of the fort, to protect it from any possible impact of blasting being carried out in these mines, the Mining Engineer, Directorate of Geology and Mining Chittorgarh, Rajasthan has approached the Indian Bureau of Mines, Ministry of Mines, Government of India, Nagpur to undertake the study the impact of blasting in mines and its effect on the Chittorgarh Fort. Accordingly, Mining Research Cell of IBM has undertaken study to monitor the ground vibrations due to blasting in the surrounding mines in the following 4 clusters:

(1) Birla Cement Limestone Mines Block-C (Jai-Surjana) of M/s Birla Cement Works Chittorgarh.

(2) Group of Manpura Stone(Farshi/Khanda) Quarries.

(3) 16 Limestone(burning) Mines near Bheiron Singh Ji Ka Khera area (Minor mineral) &

(4) China Clay & Red Ochre – (Major Mineral) Mine of M/s Waris Ali Report along with observations thereon submitted to DMG, Chittorgarh for submission in the Honourable High Court, Rajasthan.