

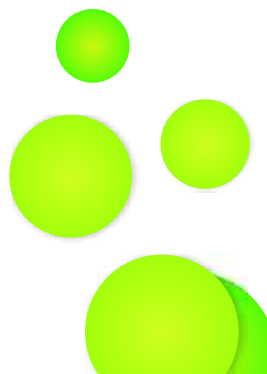
7.3 ORE DRESSING DIVISION

7.3.1 Introduction

The Ore Dressing (OD) Division was established and brought under the fold of IBM in the year 1960. The Division chiefly undertakes R&D studies in the field of Mineral beneficiation and serves the Industry's need in evolving precise & suitable technologies in mineral processing. Equipped with state-of-the-art infrastructural capabilities, such as, the Modern Mineral Processing Laboratory and Pilot Plant situated at Nagpur, which has highly advanced Ore Dressing Laboratory, Mineral Beneficiation Pilot Plant and Analytical Laboratory Complex well-equipped with modern facilities, the Ore Dressing Division undertakes extensive R&D Studies in the fields of mineral beneficiation, mineral characterisation and analysis of ores/ minerals/environmental samples besides, evolving advanced & improved technological routes & flow sheet solutions that are aimed at improving the application prospect of minerals. The Division has two additional facilities — Regional Ore Dressing Laboratories at Ajmer and Bengaluru which are sufficiently equipped with sophisticated equipment that cater to the respective regional's mineral testing and beneficiation needs.

The Present Activities of OD Division

- a) Development of beneficiation process flow sheet and know-how for upgrading of low-grade ores and minerals in laboratory-and pilot plant-scale operations and to generate process data/parameters for design of commercial concentrator.
- b) Development of process parameters for agglomeration studies.
- c) Trouble shoot operational contingencies at operating plants.
- d) Technological auditing with a view to improve plant performance.
- e) Instrumental analysis for gold, platinum, rare earth elements etc. up to PPb level.
- f) Analysis of air, water and solid samples related to environmental studies.
- g) Mineralogical studies of ores, minerals and beneficiated products.
- h) Design and layout of mineral processing laboratory and pilot plant.
- i) Selection of suitable process and material handling equipment and preparing pre-feasibility reports.
- j) To impart training in mineral processing, mineralogy, chemical/environmental analysis to scientists from overseas countries and Indian Institutions.





- k) Organise & conduct technical interactions, such as, workshops, seminars and symposia.
- l) Catering to the R & D needs in minerals beneficiation.
- m) Recovery of values from plant tailing and ore slimes.

7.3.2 Existing Structure of OD Division

The OD Division at Nagpur is headed by the Director (Ore Dressing). The Division has 2 Regional Ore Dressing Laboratories as well as chemical laboratories located at Ajmer and Bengaluru and one Modern Mineral Processing Laboratory & Pilot Plant along with Modern Analytical lab facilities at Nagpur. The Division under its fold also has a 'Clay Laboratory' at Kolkata which was established to cater to mineralogical studies on clay of North-eastern region. This Division employs personnel from Ore Dressing and Chemical science disciplines. The existing organisational structure of the OD Division is shown in **Figure 7.10**.

7.3.3 Areas of Concern

The Committee convened two interactive meetings with stakeholders of Mineral Industry. The first was held at Bengaluru on 17th May 2010 and the second at Udaipur on 19th May 2010. This was primarily hosted to secure feedback from the Industry on the role of Indian Bureau of Mines in the field of beneficiation and discuss ways to ameliorate the functioning of Ore Dressing Division in terms of improving its relevance & utility to the Industry. Thereafter one more meeting was convened on 30th August 2011 under the Chairmanship of Secretary (Mines) at New Delhi wherein senior officers of Indian Bureau of Mines and representatives of FIMI, ACC Ltd, Tata Steel Ltd and Bhagavathi Ana Lab. Pvt. Limited were in attendance to deliberate on the role & future of IBM's Ore Dressing Division.

Furthermore, the Committee accessed and examined the report & recommendations of the Working Group that was constituted in consequence of the deliberations & plan of action decided upon for IBM in the 15th Meeting of the Advisory Board of Indian Bureau of Mines held at Chennai on 7 Aug. 2009. The Working Group, which dealt on broadening the scope of mineral beneficiation and to "Develop Plan for Private Sector, Networking & Institutions and Jobs in the field of Mineral Beneficiation" submitted its report in February 2010.

The Committee drew substantial inputs/references from the aforementioned meetings held at Bengaluru, Udaipur & New Delhi and also from the recommendations of the Working Group Report and identified the following concerns which it felt need redressal/reinforcement.

7.3.3.1 There is need for a paradigm change in the structure and functioning of Ore Dressing Division. It is necessary to plan for the future and prepare a Vision Document for 2020 for mineral processing with an aim to quantifying & achieving the set objectives and targets. It is imperative also to segregate the various functions in the field of mineral processing into regulatory, regional, mine and commercial levels and restrict IBM's activities up to the first two levels only so that necessary operational

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The Ore Dressing (OD) Division was established and brought under the fold of IBM in the year 1960.

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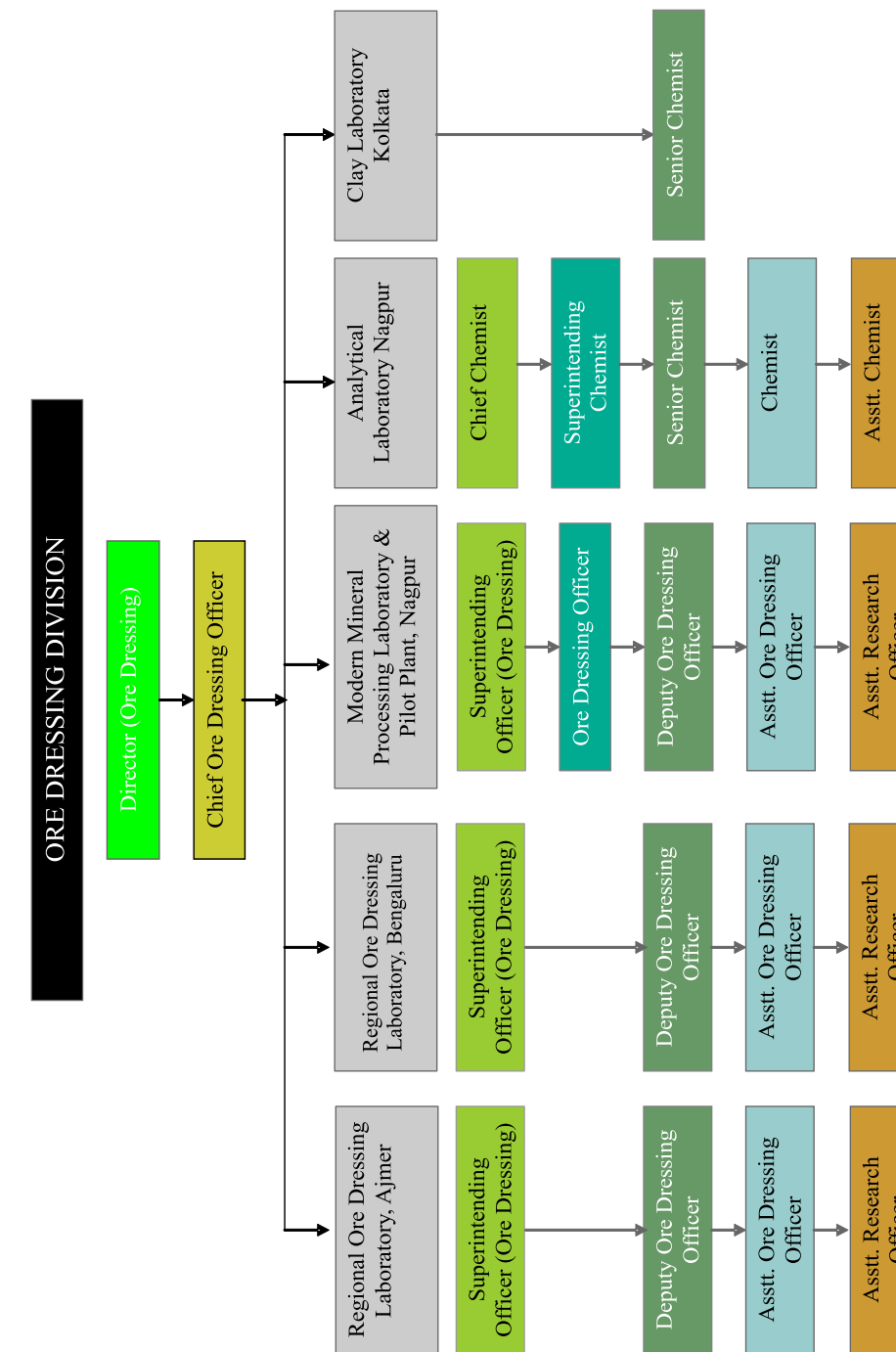


Figure 7.10 : Existing Structure of Ore Dressing Division

space for Private Sector could be apportioned. While it is necessary for IBM to oversee and crosscheck the process sheets, it may not be pertinent for IBM to be directly involved in developing business-level flow sheets. Development of business/mine level flow sheets should therefore come under the operative domain of the Private Sector.

Table 7.2 indicates the number of flow sheets developed by IBM based on the Pilot Plant investigations vis-à-vis their implementation by the Industry which is around 60%.



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Table 7.2 : Flow Sheets Developed by IBM

S. No.	Mineral	No. of flow sheets developed in IBM	No. of flow sheets adopted by Industry	No. of patents obtained
1.	Copper ore	10	05	--
2.	Rock phosphate	22	12	01
3.	Manganese ore	13	09	--
4.	Iron ore	20	15	--
5.	Limestone	11	07	--
6.	Others	49	27	--
TOTAL ...		125	75	01

Table 7.3 : Breakup of Ore Dressing Investigations by IBM on sponsored and Promotional Samples

Year	Total Ore Dressing Investigations (ODI) Completed	No. of Sponsored Investigations	% of ODI on Sponsored Basis	No. of Investigations on Promotional Basis	% of ODI on Promotional Basis
2005-06	71	42	59.2	29	40.8
2006-07	73	49	67.1	24	32.9
2007-08	66	59	89.4	7	10.6
2008-09	69	57	82.6	12	17.4
2009-10	66	49	74.2	17	25.8
2010-11	60	52	86.7	8	13.3

7.3.3.2 It is observed that despite development of cost-effective designs and improved flow sheet solutions for mineral beneficiation by IBM, the Industry was unable to put them into use due to lack of technical guidance on equipment availability and other accoutrements that are needed for implementation of such designs & flow sheet routes. As there is no intermediary mechanism or platform in place that could liaison, mitigate and offer technical support and since there is no channel for interaction and exchange of information between IBM, project consultants and equipment manufacturers, several proposals of IBM remain latent. This aspect needs fresh relook and revisitation to bring about plausible mediator mechanism.

7.3.3.3 As revealed in the analysis of the data collected, of the last few years the number of sponsored investigations greatly outnumbered the investigations that were carried out on promotional basis. A review of the work done also showed significant contribution of IBM and in certain cases the profundity of the investigation work conducted was impactful and to that extent appreciable.

Though it is observed that the awareness level of the accomplishments of IBM amongst the stakeholder is low, there is, however, room for improvement and augmentation of the technical service offered by IBM in the field of Mineral Processing Technology. At the same time, it is necessary that the Private Sector is encouraged and roped into delivering quality enhancement in the field of mineral processing through venture capital investment.

7.3.3.4 Economic prospects weigh quite significantly in commissioning any project, and setting up of mineral beneficiation plant is not an exception. Any venture, such as, R&D investigations in the field of mineral beneficiation should be proceeded with only after due consideration of market survey review for the particular mineral and certainly not in isolation of cost economics. IBM in its feasibility studies/investigations that it conducts should lay emphasis on cost-economic studies of mineral beneficiation of different routes available with the present day technology and also highlight the pros & cons of each such study prospect. The market survey studies carried out by the Mineral Economics Division could come rather handy for the purpose and therefore must be integrated into the scheme of things.

7.3.3.5 Several laboratories and organisations both in the Government, Public Sector Undertaking, as also in the Private Sector are engaged in R&D studies in mineral beneficiation. These institutions work in isolation and the benefits/outcomes of such studies are not generally shared among other user agencies. There has been an exhortation from every quarter of Industry to have a forum where information on R&D work in the field of mineral beneficiation could be resourced, accessed & utilised by prospective end-users. IBM, being in vantage position in the field could act as a nodal agency for preservation & dissemination of information on R&D work. IBM, for this, would have to devise means to collect and consolidate data on investigations carried out by various organisations active in the field of mineral processing and maintain the data bank of such information which further could be posted on a website/portal dedicated for this purpose. Realisation of such venture by IBM, would however entail serious circumspection on various counts, viz. mechanism to be developed for collection of information on R&D work carried out by various agencies; and safeguarding the proprietary rights over such information.

In the meantime, the website of IBM could be reoriented to provide IBM-centric information/service, such as,

- a) Facilities available with IBM in the field of mineral beneficiation, location wise.
- b) Mineral specific common gangue/waste materials available and technology options available for beneficiation.
- c) Interactive mechanism to offer technology solution to Mineral Industry by IBM.
- d) Abstracts of the results of the various ore dressing investigations carried out by IBM in the recent past could be posted.
- e) Provision of 'frequently asked questions (FAQ)' in the field of mineral processing.

It is observed that despite development of cost-effective designs and improved flow sheet solutions for mineral beneficiation by IBM, the Industry was unable to put them into use due to lack of technical guidance on equipment availability and other accoutrements that are needed for implementation of such designs & flow sheet routes.

IBM, being in vantage position in the field of mineral beneficiation could act as a nodal agency for preservation & dissemination of information on R&D work.



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7.3.3.6 Mineral processing especially of metallic minerals may cause environmental impacts unless proper ameliorative measures are taken. Therefore, proper waste management strategy is essential for handling of rejects, middling and tailings. Use of toxic reagents in the process can also create environmental hazards. Hence it is essential that eco-friendly reagents are used in the process. IBM should develop expertise in the field of environmental management of mineral processing to offer eco-friendly solutions. This is important from the point of view that in future all mining and mineral processing activities would be required to be carried out within the framework of sustainable development and therefore, IBM needs to develop expertise in regulation of environment in Mineral Processing Industry.

7.3.3.7 The Committee, in tune with the National Mineral Policy 2008 which advocates the concept of 'zero-waste mining', felt the need to attach considerable thrust to propagate the importance of value addition and mineral processing. The Committee is of opinion that the Ore Dressing Division of IBM should work in tandem to carry out joint studies of mineral beneficiation plants located both within and outside the mining lease area along with the officers of Mineral Development & Regulation Division (presently the MCCM Division). Although statutory provisions exist for collecting and analysing samples and monitoring every stage from plant feed to the final product, the same is not followed in totality. The Committee prescribes that regular inspection of operating plants is essential to assess plant efficiency and also have an estimation of loss of values in fines or tailing. The inspecting team would have to collect samples of plant feed, concentrate tailing and other intermediate products with a view to suggest corrective measures to improve the performance of the plants. The Committee further added that if necessary IBM should examine for amendments in the statute for inspection of mineral beneficiation plants located outside mining lease areas as well.

7.3.3.8 Power is the most important and cost intensive inputs required for mineral beneficiation of ores and minerals. In many parts of the country, power is scarce and if available it comes with high cost premium. In this context, IBM has to accommodate power & its availability as a variable in its assessment/inspection of plants. It would be therefore essential for IBM to develop expertise in the area of energy auditing of processing plants. Requisite expertise in the subject would enable IBM to jointly conduct mineral beneficiation plant auditing as well as energy auditing of the plants and devise plant-specific & suitable flow sheet solutions for processing of minerals which are both cost-effective and energy efficient.

7.3.3.9 IBM should converge its focus on applied research to develop and deploy technologies so as to improve all aspects of producing and using value-added products from minerals and metals. In collaboration with academic institutions like IITs, Indian School of Mines & National Institutes of Technologies and various other R&D organisations associated with the Industry, IBM should direct the resources at its command – both expertise and facilities – in order to facilitate discovering of breakthrough technologies in utilisation of low-grade minerals.

Besides, IBM could utilise its expertise and facilities, such as, agglomeration, sintering and other advanced methods; micro-characterisation of minerals; and advanced materials development to develop new products and services. Attempts should be made by IBM to secure its intellectual property rights so that all innovative flow sheets developed and designed by it are duly covered and should work towards obtaining international patents to protect its claim & avoid infringements.

7.3.3.10 The Regional Mineral Development Studies (RMDS) carried out by the Mining Geologists of IBM can form an important basis for determining the need for further studies in the field of ore dressing investigations. Therefore, it is essential that the scope and objectives of the RMDS need to be reoriented in such a way so as to include operative space for investigations to be conducted by the Ore Dressing Division. The Mineral Development & Regulation Division should invariably convey the outcome of RMDS to the Ore Dressing Division for taking up further initiatives as it may deem fit. It is also recommended that mineral samples generated through RMDS be subjected to beneficiation test work to explore the possibility of developing suitable economically viable process flow sheet.

7.3.3.11 The results of ore dressing investigations and that of R&D activities are not always encouraging. This has led to severe reversals in the investment flow into R&D activities in the field of mineral processing. The Committee recommends that IBM examine the issue and administer the impetus required through fiscal measures, if needed, and incentivise R&D prospects in beneficiation & mineral processing.

7.3.3.12 IBM, in order to lend the required technical support to the Industry in the field of Mineral Processing, must augment its existing facilities with upgraded machinery, instruments & equipment. Old & obsolete ways along with equipment must be replaced with modern & innovative technologies and facilities. IBM needs to commit itself to infrastructural augmentation and engender an overhaul of its equipage.

7.3.3.13 Mineralogy is an important segment of study, the comprehension of which is crucial to any investigation in the field of mineral beneficiation. The Committee therefore believes that personnel with sound background in mineralogy should be engaged in the mineral beneficiation studies. There must be regular workshops & training programmes conducted at IBM to impart requisite training & knowledge updation in the areas of mineralogy, ore dressing and other functional operations required for extraction of minerals which could be beneficial not only to its in-house personnel but also external industry personnel who are in the same field of work. IBM would have to design suitable training programmes & modules in order to achieve this purpose. It would also be equally essential that the facilities for Chemical Analysis and Environmental Laboratories are also upgraded and modernised to fulfil the desired objectives.

The Committee, in tune with the National Mineral Policy 2008 which advocates the concept of 'zero waste mining', felt the need to attach considerable thrust to propagate the importance of value addition and mineral processing.

Power is the most important and cost intensive inputs required for mineral beneficiation of ores and minerals. In this context, IBM would need to develop expertise in the area of energy auditing of processing plants.



7.3.3.14 IBM has to raise its bar in the field of mineral beneficiation & mineral processing by not only increasing the quantitative number of Ore Dressing Investigations that it handles but also by way of being proactive in rendering technical advice with respect to mineral/area specific S&T Schemes in mineral processing. IBM should not restrict its investigation studies to just examination and analysis for specific mineral(s) and identifying its/their industry-specific needs, but should offer advice or devise schemes for R&D in mineral processing especially in cases of minerals for which the country is dependent heavily on import. IBM should necessarily review the R&D work done in cases of mineral-specific ore dressing investigations and should produce status papers identifying the gaps that occur in development of flow sheets and its application for industrial use.

7.3.4 Suggested Structure for the Mineral Processing Division

In the context of the aforementioned concerns as indicated under Section 7.3.3, it is necessary to reorient the functioning of the Ore Dressing Division so that the said concerns are addressed and necessary modifications are effectuated to improve the operational efficiency of the Division. The Committee recommends the following structural changes:

7.3.4.1 The expression Mineral Processing, according to the Committee is more contemporary and would be an accepted phrase world over and would be more relevant to the existing and envisaged functions & activities of the Ore Dressing Division of IBM. The Committee therefore recommends that the appellation “Mineral Processing” be adopted and the Division be renamed as “Mineral Processing Division” instead of the existing “Ore Dressing Division”.

7.3.4.2 IBM should prepare a vision document wherein the goals and strategies as envisaged in the report in the field of mineral processing could be objectively quantified and targets for their accomplishments could be set for 2020. The Committee recommends segregating the various functions in the field of mineral processing into regulatory, regional, mine and commercial levels and that IBM should restrict its activities only up to first two levels so that necessary operational space for Private Sector could be apportioned. The Committee further opined that it is necessary for IBM to oversee and crosscheck the process sheets, but IBM should not develop business-level flow sheets on its own except for strategic minerals. Development of business/mine level flow sheets should be in the domain of the Private Sector.

The Committee further recommends that IBM should restrict its involvement with respect to development of flow sheets only in cases of such minerals which are strategic in nature and those minerals which the country heavily depends on imports. The Committee also recommends that in addition to beneficiation, IBM should also undertake R&D studies in respect of the recovery of minor metals, technology metals, energy critical metals etc. The Committee would like to assert that development of flow sheet by IBM for value additions of such strategic minerals

highlights

IBM has to raise its bar in the field of mineral beneficiation & mineral processing by not only increasing the quantitative number of Ore Dressing Investigations but also by way of being proactive in rendering technical advice with respect to mineral/ area specific S&T Schemes in mineral processing.

The Committee feels that it is necessary for IBM to oversee and cross-check the process sheets, but IBM should not develop business-level flow sheets on its own except for strategic minerals.

The Committee recommends that a National level “Mineral Processing Governing Council” headed by the Secretary (Mines) with Director (Ore Dressing) as Member Secretary be constituted.

would not only to a large extent reduce the import burden but also will help the country develop a niche expertise in the field of Mineral Processing Technology.

7.3.4.3 The Committee recommends that a National level “Mineral Processing Governing Council” headed by the Secretary (Mines) with Director (Ore Dressing) as Member Secretary and that which involve various stakeholders be constituted. This Council would govern IBM's role in furthering Mineral Processing Technology in the country and intervene whenever it deems fit so that the country's mineral needs are purposefully served. The terms of references for this Governing Council and its constituent members as recommended by the Committee are furnished in **Appendix -1**.

7.3.4.4 The Committee observed that the National Mineral Policy 2008 enumerates that conservation of minerals shall be construed not in the restrictive sense of abstinence from consumption or preservation for use in the distant future but as a positive concept leading to augmentation of reserve base through improvement in mining methods, beneficiation and utilisation of low-grade ores & rejects and recovery of associated minerals. There shall be an adequate and effective legal & institutional framework mandating zero-waste mining as the ultimate goal and a commitment to prevent sub-optimal and unscientific mining. Non-adherence to the Mining Plan based on these parameters will carry repercussions. Mineral sectoral value addition through latest techniques of beneficiation, calibration, blending, sizing, concentration, pelletisation, purification and general customisation of product will be encouraged. This is particularly important in iron ore mining as about 80% of the iron ore produced in the country is in the form of 'Fines' and to promote such value addition fiscal and non-fiscal incentives will be considered. A thrust will be given to exploitation of mineral resources in which the country is well-endowed so that the needs of domestic industry are fully met keeping in mind both present and future needs, while at the same time exploiting the external markets for such minerals.

The Committee, therefore, feels that to achieve the aforesaid goals in the field of mineral processing, IBM needs to:

- Develop an adequate and effective legal and institutional framework for mineral processing mandating zero-waste mining as the cardinal goal.
- Mechanism to make it statutory for value addition of minerals through Schemes of Mining.
- To encourage value addition through latest techniques of beneficiation, calibration, blending, sizing, concentration, pelletisation, purification and general customisation.

7.3.4.5 The Committee further observed that the contribution of the Manufacturing Sector at just over 16% of India's GDP is much below its potential and a cause of concern especially in the context of other Asian countries in similar stages of development. This also has its socio-economic manifestations and prevents India



from fully leveraging the opportunities of globalisation. The major objectives of the National Manufacturing Policy are to increase the sectoral share of manufacturing in GDP to at least 25% by 2022; to increase the rate of job creation so as to create 100 million additional jobs by 2022; and to enhance global competitiveness, domestic value addition, technological depth and environmental sustainability of growth. In this context the Committee felt that to serve the need for raw material in the form of minerals and metals by the Manufacturing Sector, the Mineral Industry should come with a sustainable dynamic plan for value addition. The Committee, therefore, envisages a greater necessity for regulation in the field of mineral beneficiation in the future and recommends that IBM should look after the regulatory aspect of mineral beneficiation. IBM should develop mechanism to check Mining Plans and Schemes to ensure that the feasibility aspect for beneficiation is in place along with mine development plans. Once the process sheet analysis/checking becomes a mandatory part of approval of Prospecting Report, Mining Plan and Mining Scheme, the Committee feels that the prospect of growth in mineral beneficiation would exponentially rise.

7.3.4.6 For IBM to perform the task of a mineral beneficiation regulator, the Committee recommends that the Mineral Processing Division of IBM must be reorganised as indicated in Figure 7.11. The Committee also recommends that IBM should carry out the regulatory work in the field of mineral beneficiation as indicated in **Appendix -2**.

7.3.4.7 The Committee in its observations noted that revenue generation through consultancy in mineral processing was just 10% of the salary component of OD Division. It was also learnt by the Committee that in compliance with the directives of the IBM Advisory Board, IBM's engagement in mineral beneficiation was purely restricted as non-commercial venture and that the revenue generation through such consultancy means was merely incidental to its core activities of conservation of minerals. It was also observed that the rates prescribed by IBM for laboratory and pilot plant investigations were highly subsidised and that the rates were not enhanced for the last 5 years and no new equipment was procured for the Ore Dressing laboratories in the last 10 years. However, in order to maintain parity between the nature of beneficiation assignments undertaken and the investment of human resource & its expertise in fulfilment of such highly sophisticated technical assignment, the Committee recommends enhancement in the consultancy charges levied by IBM in commensuration with the variable parameters that accost such assignments so as to bring out rationalisation in the dispensation of such works.

7.3.4.8 The Committee recommends that IBM slants its emphasis to the prospect of mining small deposits having low-grade ores but with high tonnage and gradually adopt the concept of cluster mining. The beneficiation techniques too need to be developed at par with the international standards with state-of-the-art facilities in place for extraction of high value and strategic minerals. IBM should desist promotional R&D at mine level and undertake only pre-competitive and regional

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- IBM must slant its emphasis in encouraging the prospect of mining small deposits having low-grade ores with high tonnage and should gradually adopt the concept of cluster mining.

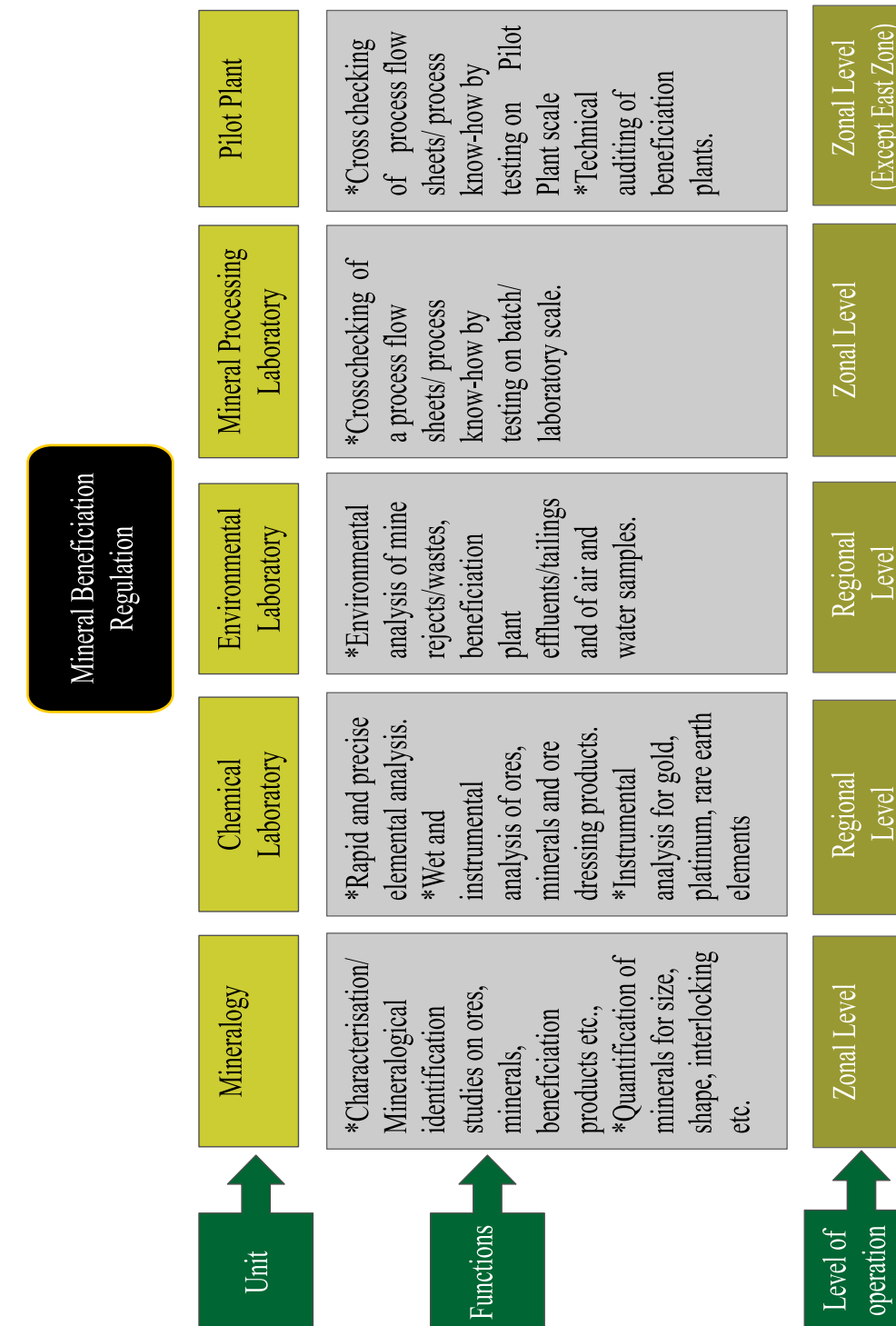


Figure 7.11 : Reorganisation of Ore Dressing Division for Regulation of Mineral Beneficiation



R&D required for general understanding of scope of the problem. IBM should encourage process R&D on business lines to prepare flow sheets that would ensure higher explorability of low-grade ores.

7.3.4.9 The Committee recommends that IBM in pursuance of development of new technological innovations in mineral processing should patent them in order to enhance its visibility both nationally and internationally. IBM should increasingly undertake collaborative ventures with academic and R&D institutes within India and abroad. IBM should broaden its technical applicability and prepare schemes for applied research and for technology development in collaboration with Institutes of high repute. The Committee is of the view that such collaborative venture would eventually facilitate IBM to gravitate towards hydrometallurgical processing including bio-leaching, solvent extraction, ion-exchange and also develop metallurgical processes. The Committee also recommends that IBM pursues its research programme in emerging fields, such as, recycling and evolving environment-friendly techniques to facilitate the process of recovery of metals from scrap and waste like electronic waste, base metals, electronic metals etc.

7.3.4.10 IBM carries out investigations both on sponsored and promotional basis. The numbers of sponsored samples vary depending on the flow. For promotional basis investigations, IBM needs to evolve mechanism to identify areawise/mineralwise samples to be taken up for investigations. The Committee in its observation has put forth a three-stage mechanism as described below and schematically represented in **Figure 7.12** to streamline the flow of such investigation assignments.

a) Consultations

IBM in consonance with the decisions of the “Mineral Processing Governing Council” and in consultation with stakeholders – industry personnel, State Directorates of Mines & Geology, other R&D institutes etc. should prioritise areas of investigations. Such a process, it was felt, would eliminate duplication of work. The Meeting of the Mineral Processing Governing Council and other consultative meetings should be organised preferably in the month of October or November each year.

b) Target Setting

Based on the deliberations and outcome of the Consultative Meetings, targets should be set for the next programme year in respect of mineralogical examinations, chemical analysis and ore dressing investigations. While setting targets, the number of sponsored samples to be taken up for investigation during the ensuing year should also be finalised and a neat roster schedule needs to be drawn up in advance.

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The Committee recommends that IBM in pursuance of development of new technological innovations in mineral processing should patent them in order to enhance its visibility both nationally and internationally.

IBM should organise Seminar/R&D Meet/Workshop on an annual basis to highlight the work carried out by IBM and other R&D institutions and to educate the Mineral Sector of all the latest in Mineral Processing.

c) Mineral Processing Meet

IBM should organise Seminar /R&D Meet /Workshop on an annual basis to highlight the work carried out by IBM and other R&D institutions and to educate the Mineral Sector of all the latest in Mineral Processing. Such annual seminar would also provide a platform for exchange of information on R&D work carried out in the field of mineral processing. The Committee also recommends creation of a dedicated portal attached to IBM's web portal for dissemination of research outcomes and for browsing countrywide online research database on mineral processing & beneficiation studies. This will also enable project consultants and equipment manufacturers to establish direct links with all stakeholders which in turn will facilitate the process of exchange & transmission of information. Such R&D meet should be preferably organised in the month of February/March every year.

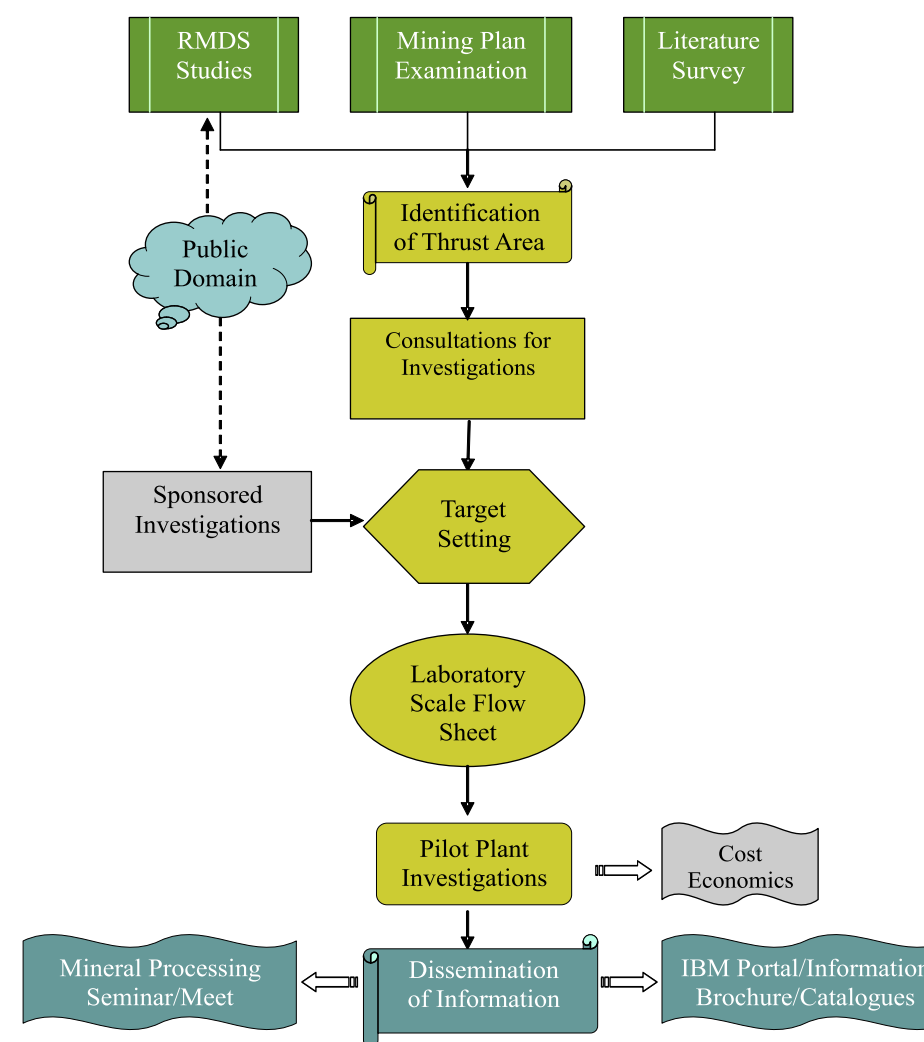


Figure 7.12 : Model Mechanisms for Ore Dressing Investigations



highlights

7.3.4.11 Ore Dressing generally involves the following routes:

- a) **Amenability Studies:** These are studies conducted on exploration samples to assess the beneficiation characteristics of the ores and ascertaining the possibilities of obtaining suitable grade concentrates.
- b) **Characterisation Studies:** Studies that are conducted on ores, rocks, sinters, slags etc. for quantification of minerals based on attributes, such as, size, shape, interlocking volumetric grade distribution etc.
- c) **Laboratory-scale Studies:** Such studies are conducted on a few kilograms of ores samples to develop a viable process flow sheet so as to establish grades of concentrates which can be produced with desirable recoveries.
- d) **Pilot Plant Studies:** These studies are conducted normally at 0.2 to 0.5 tph capacity basis where large numbers of continuous test runs are carried out to optimise the process parameters and reagent conditions developed in laboratory-scale investigations.

Amenability tests are preliminary in nature which give a fair idea to assess the beneficiation characteristics of the ores and therefore help to know whether the minerals can be subjected to economical mineral processing. Such a study in the very beginning of the prospecting stage, in the view of the Committee, would give a strong impetus to scientific and systematic mining. However, the Committee did observe that due to absence of any statutory provision, the miners often omit conducting amenability tests. The Committee, therefore, insists that statutory provisions be made to make it necessary to carry out Amenability test in respect of exploration samples of drill cores for grant of Prospecting and High Technology Reconnaissance-cum-Exploration Licence. The Committee would like to assert that this would be in line with the stipulations as laid out in the new Mines & Minerals (Development & Regulation) Act 2011 Bill where it specifies that no mining lease will be granted without due completion of prospecting operations.

7.3.4.12 The Committee observed that the perception of the Mining Industry, as highly uncongenial destination for investments is the primary cause of entrepreneur reluctance to invest in R&D activities in the Sector. The main stimuli for attracting investment presently are strategic importance of minerals, market availability and returns on value additions. The Committee in order to encourage more R&D work in the field of mineral processing recommends that IBM devise such incentivising scheme consisting of both fiscal and non-fiscal measures for each mineral so that the prospect becomes covetous for mineral beneficiation investigations.

7.3.4.13 IBM in the present framework has no statutory powers to inspect beneficiation plants located outside the lease area. Inspection of beneficiation plants is essential to assess plant efficiency and loss of values in fines or tailing.

IBM after conducting investigations can suggest corrective measures to improve performance of plants and thus improve recovery of useful material. Apart from plant auditing with the objective to optimise the beneficiation process, IBM should also carry out the energy auditing of the plant. This would serve dual purpose of energy conservation and optimum recovery of minerals which ultimately would lead to zero-waste mining. The Committee, therefore, recommends that necessary amendments in the statute for inspection of mineral beneficiation plants located outside the mining lease areas be effectuated.

7.3.4.14 Training and Capacity Building**a) Training**

Training is integral to any scientific developmental process. Newer Technologies & advancements often do displace the older ones rendering them obsolete. The concept of constant upgrading is the essence for retaining qualitative value in the human resource that are at work. The Committee suggests that IBM officials involved in the field of mineral processing should have adequate opportunities to be exposed to the advancements that are taking place nationally & internationally so that development of in-house expertise, absorption of techniques and contributions to the field could be nurtured and accomplished. IBM to fulfil its Training obligations should chalk out a training calendar that includes the relevant training programme, in the field of mineral processing which could be imparted through in-house means or through external academic and R&D institutions of repute. In view of the present expertise status, the Committee feels that IBM's OD Officials would require training to be imparted in the field of energy auditing, hydro-metallurgy and advancement in conventional mineral processing techniques. Simultaneously, participation in national and international seminar/symposia and presentation of papers at such events should be encouraged.

b) Strengthening and Setting up Environmental Laboratories

IBM's Environmental laboratories at Nagpur and Bengaluru are equipped to analyse environmental samples, such as, air, water, mine effluents, soil etc. These Environmental Laboratories of IBM are also recognised by the Ministry of Environment and Forests and facilities available are utilised for monitoring environmental parameters in and around the mining areas. In discharge of its other regulatory functions, preparations of baseline data and other environment-related assignments are also handled by IBM's Technical Consultancy Division which also extends its services for the Industry on charge basis. As is envisaged, IBM is likely to play the role of nodal agency for monitoring environmental performance of various entities in the Mining Industry and also oversee compliance of the entities with conditions laid out for grant of environmental clearance by the Ministry of

IBM in the present framework has no statutory powers to inspect beneficiation plants located outside the lease area. Inspection of beneficiation plants is essential to assess plant efficiency and loss of values in fines or tailing.

Training is integral to any scientific developmental process. The concept of constant upgrading is the essence for retaining qualitative value in the human resource that are at work.



Environment and Forests. For IBM to fulfil this role, the Committee recommends that a full-fledged capacity for carrying out analysis of mine environmental samples and also for monitoring of environment conditions be developed and made functional. This warrants strengthening of the existing environmental laboratories of IBM with expert hands, materials and resources. The Committee further recommends that Environmental Laboratory at each Regional level office be set up with state-of-the-art infrastructure.

c) Setting up of Regional Ore Dressing Laboratory at Kolkata

The Committee in ante-chapters of the Report has recommended creation of East Zone with Kolkata as/ its headquarters. The proposed Eastern Zone will have its territorial Jurisdiction and control over Bhubaneswar, Ranchi and the entire North-Eastern part of the country. The areas falling under Eastern Zone would need substantial regulation and regional level studies in the field of beneficiation in respect of the minerals, such as, iron ore, manganese ore, bauxite, chromite, graphite, limestone, clay, etc. The Committee, therefore, recommends that the existing Clay Laboratory at Kolkata, presently headed by a Senior Chemist be fully refurbished and converted into a Regional Ore Dressing Laboratory.

d) Augmentation with New Instruments

The Committee observed that the equipment and machinery available & utilised at IBM's laboratories are old and obsolete and need to be replaced with new and sophisticated versions. Besides commissioning higher version equipment and instruments, IBM needs to upgrade and equip its laboratories with new generation equipment and machinery for faster and reliable investigations. The Committee further suggests that the following new machinery be commissioned and put into utilisation.

(i) Instrumented Laboratory Flotation Cell with Level Controller (1 No.) : At present all the three laboratories are equipped with Denver Model sub-aeration flotation cells. In this machine the impeller speed is manually varied and measured and so is the air flow rate which is manually varied. In contrast, the new flotation cell allows for the analysis of flotation performance incorporating the effect of bubble size, grind size, reagent addition and residence time. These machines are designed for high accuracy required in floatability modeling and simulation. Further, the bottom driven impeller allows full scraping of the froth for concentrate removal and the electronic digital read-out accurately display impeller speed to $\pm 0.1\%$.

highlights

The Committee has recommended creation of East Zone with Kolkata as its headquarters. The proposed East Zone will have its territorial Jurisdiction and control over Bhubaneswar, Ranchi and the entire North-Eastern part of the country.

This machine is sophisticated and will help generate accurate/reliable data, besides, its precision levels to generate process parameters in flotation are highly rated.

(ii) ICP - AES Instrument, Closed Microwave Digestion Unit and Argon Gas Cylinder (1No.) : The Inductively coupled Plasma-Atomic Emission Spectrometer (ICPAES) technique is based on emission of radiations by elements at about 8000°K for simultaneous determination of metals and non-metals both refractory and non-refractory in ores, minerals, ore dressing beneficiation products and environmental samples – air, water and mineral waste at ppm, sub-ppm and ppb concentration. A small quantity of a sample can be analysed for a large number of elements – about 32 elements could be simultaneously analysed for screening and quantitative estimations.

This instrument will be useful for simultaneous analysis of multi-elements in ores, water and precious metals.

(iii) Mineral Jig (Lab. Model) (For Nagpur & Bengaluru) (2Nos.) : At present the ore dressing laboratories in Nagpur and Bengaluru are equipped with Mineral Jig Denver model, where jigging operations are carried out on minus 10 mesh sample. The aforesaid new mineral jig is capable of taking feed material up to 10 mm which is extremely useful for gravity separation at coarse size.

(iv) Wet High Intensity Magnetic Separator (up to 16 kilogauss) (1 No) : At present all the three laboratories are equipped with Wet High Intensity Magnetic separators whose magnetic intensities vary from 2000 to 15000 gauss.

This newly recommended Wet High Intensity Magnetic Separator can produce magnetic intensity up to 16000 gauss and comes with some additional features for better recovery of even feebly magnetic material. This equipment will be useful especially for chromite and iron ore samples.

(v) Pot Sintering Machine (1No) : This machine is utilised for carrying out sinter pot test. The sinter pot is designed according to the requirements of real plant conditions. The sinter pot test is conducted for several different purposes but the main aim is to evaluate the influence of different sinter mixture composition on the quality of the sinter product. The results of the sinter pot test can also be used for sinter process optimisation. From the results of the sinter pot tests, the sintering behaviours of the raw material in the sinter mixture are determined—typical quality measures being production rate, fuel consumption rate and sinter quality. Therefore, this machine is essential to facilitate pot sintering studies.

(vi) Briquetting Press (1No) : This machine is required for carrying out briquetting studies on ore fines. It is utilised for iron ore briquetting where the main ingredient are iron ore concentrate, reducing agent & fluxes, binder, mixer and briquette strengtheners. Commissioning of this machine would enhance the capacity of IBM.



(vii) *Atomic Absorption Spectro-photometer with Graphite Furnace Attachment (1No for Bengaluru)* : This latest version of Atomic Absorption Spectro-photometer with graphite furnace attachment is an advance piece of equipment used for analysis of ores and minerals to detect/trace major elements. This will also be required for upgradation of the existing AAS machine which is more than 15 years old.

Appendix-1 : Constituent Members of the Proposed Mineral Processing Governing Council

Sl.No.	Name	Position
1.	Secretary (Mines), Ministry of Mines, Government of India	Chairman
2.	Joint Secretary (Mineral Policy & Regulation), Ministry of Mines, Government of India	Member
3.	Controller General, Indian Bureau of Mines	Member
4.	Director General, Geological Survey of India	Member
5.	Director, National Metallurgical Laboratory	Member
6.	Director, National Institute of Interdisciplinary Science & Technology, Thiruvananthapuram	Member
7.	Director, Advanced Materials and Processes Research Institute (AMPRI), Bhopal	Member
8.	Director, North-East Institute of Science and Technology (NEIST), Jorhat	Member
9.	Director, Indian Institute of Integrative Medicine, Jammu	Member
10.	Director, The Institute of Minerals and Materials Technology, Bhubaneswar	Member
11.	Director, Jawaharlal Nehru Aluminium Research, Development & Design Centre, Nagpur	Member
12.	Director, Centre for Techno-Economic Mineral Policy Options, New Delhi	Member
13.	Director/Head of the Department, Department of Material Science/Metallurgy, Indian Institute of Science, Bengaluru	Member
14.	Director/Head of the Department, Department of Mineral Engineering, Indian School of Mines, Dhanbad	Member
15.	Representatives from Department of Metallurgy/ Ore Dressing/ Material Sciences/ Mineral Engineering, of leading Academic Institutions	Member(s)
16.	Representative of FIMI/CII/FICCCI/ASSOCHAM	Member(s)
17.	Director of Mines & Geology of mineral-rich States	Member(s)
18.	Representatives of Private Sector Mineral Processing Laboratories	Member(s)
19.	Representatives of Industries having Mineral Beneficiation Plant	Member(s)
20.	Director (Ore Dressing), Indian Bureau of Mines	Member Secretary

Suggested Terms of References of the Mineral Processing Governing Council

1. To suggest the work programme with respect to the Mineral Processing investigations to be pursued by IBM.
2. To examine the effectiveness of mine level and regional level beneficiation efforts.
3. To suggest technological options in mineral processing with special emphasis on strategic minerals.
4. To advise for studies to be taken up to identify the nature of environmental impacts caused on account of mineral processing.
5. To identify the thrust areas for undertaking Pilot Plant level studies.
6. To identify the gaps in the Sector at national level and provide necessary remedial directions.
7. To examine the efficacy of mineral beneficiation regulation and suggest legal measures.
8. To suggest viability measures, such as, tax benefits for encouraging mineral beneficiation and value addition work.
9. To recommend instrument procurement for IBM and state DGMs with a view to upgrade capacity and increase operational efficiency.
10. To suggest measure for better interactions amongst stakeholders and wider dissemination of technology.

Supplementary Terms of the Council

The tenure of the Governing Council in normal circumstances should not exceed more than five years. The Governing Council should meet at least once every year. IBM would provide the secretarial assistance to the Council.

Appendix-2 : Mineral Beneficiation Regulation Activities to be Carried Out by IBM

1. Check implementation of proposals of beneficiation and mineral processing envisaged in the approved Mining Plan/ Scheme of Mining and their monitoring for compliance.
2. Crosscheck the process flow sheet using the basic wherewithal at RODL
3. Verify feed grade, concentrate grade, tailing grade at regular interval.
4. Verify recovery percentage and estimation of tailing loss
5. Check toxic elemental concentration if any in tailings/slimes and their environmental hazards and pursue action for remedial measures.



6. Verify Recycling of water to avoid over exploitation of ground water.
7. Check proper end use of concentrate in accordance with specification of user industry.
8. Suggest necessary remedial measures for plant performance upgradation and possible recovery of losses in tailings.
9. Build up awareness about latest technologies for better utilisation of low-grade/sub-grade ores.
10. Suggest proper mineral processing techniques for optimum utilisation of ROM and recovery of associated minerals and by-products to ensure zero-waste mining concept.
11. Check and monitor air, water and noise level and other environmental parameters during mining and plant operation and suggest remedial measures to mitigate the pollution levels.
12. Study of different ore/minerals grades, mining technology and existing processing units/ beneficiation plants in a cluster for specified mineral to develop regional level beneficiation model for optimum utilisation of said mineral. For better understanding on regional level beneficiation aspect:
 - a) Physical, Chemical and Mineralogical Characteristics of Ore and waste need to be studied.
 - b) Study of existing beneficiation/mineral processing units for understanding the current scenario and correlation of process flow sheets.
 - c) Amenability studies of ores through basic R & D facilities at RODL, IBM
 - d) Collection of samples from different mines and plants and their analysis.
 - e) Develop regional level basic flow sheets and suggest lessee to develop minewise commercial flow sheet by investment/ joint venture.

