PROF. S.K.BOSE MEMORIAL LECTURE 2004

by

Prof. S.P.Banerjee
Former Director-in-charge
Indian School of Mines, Dhanbad

Mineral Availability and Environmental Challenges - A vision 2020 Statement

1. Introduction

I consider it a great honour to be invited by ISM to deliver the Prof. S.K.Bose Memorial Lecture this year. I was a student of Prof. Bose at Indian School of Mines during the period 1953-56. He was an eminent teacher with a brilliant academic record, a sharp mind belied by his trade mark humility and mild manners, a ready wit and well known for his kindly disposition to his students and colleagues. Even in those days he showed his concern for protection of the environment and wrote about the Jharia coal field fires. I have chosen the topic of Mineral Availability and Environmental Challenges - A vision 2020 Statement for the Memorial lecture.

The growth target of Indian economy during the Tenth Five Year Plan has been fixed at 8% per annum. This is a relatively high growth rate compared to the earlier achieved figure of 6.1% during the Eighth and Ninth Plans but has been considered necessary for making a quick dent on the widespread poverty and unemployment in the country. To achieve 8% growth of the economy, the industrial sector must grow at a higher rate of, say, 10%. Such a rapid growth of the industrial sector is possible only if there is an abundant supply of energy, metals and minerals. The core sectors of the economy, such as the hydrocarbon, steel, coal, electricity etc. require heavy investment and long term planning. The vision statements for various core sectors of the economy show the increasing demand for minerals for meeting which the mining sector of the country will have to greatly expand. This paper examines the growth prospects and environmental implications of such a rapid growth of the mining sector and discusses the various measures likely to be adopted by the mining industry for protection of the environment.

2. Energy Minerals

The energy sector plays a crucial role in the overall development of the economy. Of the total energy consumption of approximately 360 Mt of oil equivalent in the country, an estimated 35% is obtained from traditional sources such as fuel wood, agricultural waste, animal dung etc. and other 65%, termed as commercial energy, is obtained from coal, oil, gas, hydel, nuclear and renewable sources. The share of various energy sources in the primary commercial energy consumption of the country in 1997-98 was(1)

Coal and lignite	56%
Petroleum	32%
Natural gas	8%
Hydel	3%
Nuclear & renewables	1%

Coal and lignite are mostly used in power stations (75%), steel plants (6.2%), cement plants (3.6%), other industries and brick making plants (15.2%). Petroleum and natural gas are mostly used for the transportation sector although significant amounts are used in oil and gas fired power stations, fertiliser plants, other industries and in the domestic sector for cooking and lighting.

Electricity is the preferred form of energy for use by the industry and is a crucial requirement for expansion of the industrial and agricultural sectors. Of the installed generating capacity of 105000 MW in 2001- 02, 71% was based on thermal, 25% on hydel and the remaining 4% on nuclear and renewables. The Tenth Five Year Plan envisages an expansion of 40% of the installed generating capacity amounting to an addition of 41000 MW by 2006-07 and a further addition of 60000 MW capacity is planned for the Eleventh Plan period (2011-12). The bulk of the power generated (approx. 74%) comes from coal and lignite fired power stations and the proposed expansion of the power sector is based on an expansion of this sector. The expansion of the gas based thermal generation depends on discovery of new gas deposits in the country or import of gas from nearby countries. Although oil and gas contribute 40% of the primary energy consumption in the country, India has only limited proved reserves of these commodities and the domestic production accounts for hardly one third the consumption of these two items. The reserves to production ratios of oil and gas are only 15 and 23 years respectively. Till recently, oil import bill was accounting for one third of the total value of imports into the country and with the recent spurt in oil price, the share of oil import bill would rise further. India Hydrocarbon Vision 2025 Report of GOI gives the current oil elasticity with respect to GDP as 1.1 (i.e. for every 1% growth in GDP, oil consumption increases by 1.1%) and has proposed measures to bring it down to 0.7 by 2025. The Vision document also proposes vastly increased exploration efforts towards finding oil and gas resources in the country but no great change (except perhaps for a small contribution to the gas resources by exploitation of coal bed methane) in the scenario is expected in the short term or till a major discovery takes place.

The nuclear power stations contributed 17 Billion kWh (or approximately 3% of the total) towards the energy generated in the country in 2003-04. The Vision document of the

Department of Atomic Energy proposes to raise the installed generating capacity of the nuclear power plants from the current 2720 MW to 20000 MW by the year 2020, which would still be a small percentage of the total generating capacity of the country.

Hence, for the foreseeable future, coal and lignite will remain the main source of power generation in the country. The demand for coal by the power sector has been estimated as 317 Mt in 2006-07 and 469 Mt in 2011-12. The sector wise demand and company wise availability of coal at the end of X and XI Plans are given in Table 1(2).

The bulk of Indian coal reserves are of inferior grade (i.e. E and F grade) and the power stations are designed to burn such high ash coals. Currently some 60% of CIL production is of inferior grade and by 2011-12 this percentage figure is expected to go up to 69% (3). As per a 1997 amendment of the Environment Protection Rules 1986, power stations located over 1000 km away from the pit heads or in urban areas with critical air pollution concerns have to use beneficiated coal having an ash content not exceeding 34%. Currently some 34 power stations using 93 Mt of coal come under this stipulation which is met partly from the operation of the seven non-coking coal washeries of CIL but mostly by blending the high ash coals with available low ash coal. The true spirit of the amendment can, however, be achieved only by setting up of a large number of pit head washeries for which CIL favours the Build-Own-Operate route. Installation of a large number of coal washeries would confront the coal industry with the environmental problem of disposal of washery rejects.

Table 1 Sector wise demand and company wise availability of coal

Year Sector wise Demand	2006-07 (in Mt)	2011-12 (in Mt)
Coking coal	37.2	40
Non-coking coal		
Power (utilities)	317.1	469
Captive power	28.3	32
Cement	24.6	24
Fertiliser	4.2	5
Others	49.1	50
Total Demand	460.5	620
Availability of Coal		
CIL	350	445
SCCL	36.1	35.4
Others	18.9	44.6
Total Availability	405	525

3. Minerals for the steel industry

The per capita steel consumption of 32 kg in India is well below the world average of 150 kg. After liberalisation of the economy and with emphasis on infrastructure and industrial development in the country, the steel production is poised for a rapid growth at six to eight percent per year. Some of the projections made for steel production in the country in the coming years have put a figure of 50 Mt in 2010 and 100 Mt in 2020(4). Such a large production of steel would need correspondingly large tonnage of iron ore and coking coal.

The total iron ore reserve of India has been estimated at 17712 Mt (12317 Mt hematite and 5395 Mt of magnetite) of which 13423 Mt (9919 Mt of hematite with plus 58% iron content and 3504 Mt magnetite with 30-40% iron content) is the recoverable reserve. India has been a traditional exporter of 20 to 30 Mt of iron ore per year to Japan and China but the heavy demand from China has pushed up the export figure to over 50 Mt in 2003-04. The country is in a position to meet the expanded domestic demand of iron ore and can still support a modest amount, say, 50 Mt/year for export. Thus for meeting the needs of 100 Mt/year of steel production, the country will need 150 Mt/year of iron ore and adding 50 Mt for export, the iron ore mining sector has to increase production level to 200 Mt/year by the year 2020.

The coking coal requirement for 100 Mt of steel production would be around 65 Mt. The country does not have enough good quality coking coal resources and even at the end of the Tenth Five Year Plan (2006- 07) when steel production will be only 38.2 Mt, an import of 20 Mt of coking coal has been envisaged(5). The situation can be very serious for the steel industry if the coking coal price in the international market increases sharply as it happened last year. There is an urgent need to muster the political will to evacuate the residential areas in Jharia coalfield and extract as much of the indigenously available prime coking coal as possible by opencast mining.

4. Aluminium and Bauxite

Indian production of aluminium has risen steadily from 0.45 Mt in 1993-94 to approximately 0.82 Mt in 2003-04. Aluminium is used principally in electrical, transmission, transportation, construction and packaging industries. For every tonne of aluminium production, approximately 5.7 t of bauxite has to be mined. India has approximately 2650 Mt of bauxite reserve which constitutes 7% of the world reserve of bauxite. The aluminium sector grew at a rate of six percent during the IX Plan and the Planning Commission has set a higher target of 8% growth for this sector during the Tenth Five Year Plan period. The working group on mineral exploration and development for the Tenth Plan has projected a production of 0.92 Mt and 1.28 Mt of aluminium at the end of X and XI Five year Plans respectively but the actual productions are likely to exceed the targets.

Besides its use as the raw material for production of aluminium, significant quantities of bauxite are used as refractory and in cement and steel industries. With the projected expansion of aluminium, steel and cement industries, the demand for bauxite will greatly increase in future and new bauxite mines are likely to be opened up for the purpose.

5. Copper metal and copper ore production

According to the National Inventory of minerals, there is approximately 461 Mt of recoverable copper ore of 1.02% grade in the country(6). During the VIII Plan period an average of 5.2 Mt/y of copper ore was mined but the figure declined sharply during the IX Plan period to an average of 3.76 Mt/year due to closure of the loss making Mosabani group of mines in the Singbhum belt. International price of copper has been widely fluctuating from a high of $2844/t in 1995-96 to a low of $1581/t in 1998-99 and has again crept up to $3000/t in March 2004. The decision to close the Mosabani group of mines was taken in the late 1990s but after the recent rise in copper price, there is a talk of reopening some of the closed mines.

Growth of the electrical and transportation sectors has greatly increased the demand for copper in the country. Hardly 40000 t of the total demand of 300000 t of copper in 2002-03 was met by smelting of indigenously produced ore. The grade and nature of the copper deposits in the country are such that not much increase in mine production is envisaged during the X and XI Plan periods. The two private sector players in the copper smelting sector, namely Birla Copper and Sterlite Industries have developed smelter capacities of 150000 t each based on imported copper concentrates and have plans to double their capacities during the X Plan period. The working group on mineral exploration and development for the Tenth Plan has projected a production of 0.78 Mt and 1.09 Mt of copper at the end of X and XI Five year Plans respectively.

6. Lead and Zinc minerals

India has approximately 176.8 Mt of recoverable reserves of lead and zinc ores and a life index of about 40 years(7). The port based zinc smelters at Vizag and Alwaye use imported zinc concentrate. The production of primary zinc metal was estimated at 221000 t in 2003-04 and a further 30000 t of zinc was produced from secondary sources such as dross and scrap. The expansion of Rampura-Agucha mine (from 4500 tpd to 11400 tpd) and the opening of Sindesar Khurd mine are expected to double the output of lead-zinc ore mined in the country but the life index of ore reserves would be considerably reduced.

The demand for lead and zinc has grown at an annual rate of 6.5% and 6% respectively during the IX Plan. The expansion of the steel sector is likely to greatly increase the demand for zinc used for galvanizing steel during the X and XI Plan periods. The paucity of good lead-zinc deposits in the country means that an increasing quantity of import of lead-zinc metals and concentrates can be expected in the future years. The working group on mineral exploration and development for the Tenth Plan has projected a production of 0.394 Mt and 0.54 Mt of zinc at the end of X and XI Five year Plans respectively.

7. Cement industry

With a production of 114 Mt, India ranks third amongst the cement producing countries of the world. Since the delicensing of the cement sector in July 1991, the industry has grown at an average rate of 8% and with the spurt in growth of infrastructure and housing sectors during the X Plan period, the cement demand is likely to grow at a similar rate in the coming years. Hence an expansion of the existing limestone mines and opening of new mines are envisaged during the X and XI Five Year Plan periods. India with its 52000 Mt of cement grade limestone reserves is comfortably placed for further growth of the cement industry.

8. Main environmental problems of an expanding mining sector

Some of the environmental problems caused by mining will accentuate with growth of the mining sector. Such problems can be listed as

* Land damage, deforestation and change in land form
* Water pollution and Disturbance to hydrologic regime
* Ground vibration from blasting
* Disturbance to wildlife
* Involuntary displacement of persons
* Relationship with the surrounding community

A few of the problems are site specific such as those relating to water pollution by hexavalent chromium in the chromite belt or sliding down of waste material dumped on slopes in hilly terrain. The environmental problems caused by surface subsidence is also specific to underground mining and generally confined to flat to moderately dipping deposits i.e. to coal mines only.

9. Land damage and change in land form

Opencast is the predominant method of mining today and the share of opencast mining is likely to go up in future. The bulk of the coal, lignite, copper ore and lead-zinc ore would be won from large and deep mechanized opencast mines with ample overburden. As shown in Table 1, the coal demand in 2011-12 would be 620 Mt and with a growth of 8% per year, the demand may touch 1150 Mt by the year 2020. Such large demands can be met only by opening up of new large opencast mines or expanding the existing ones. CIL has planned for expansion of three of its large opencast mines, namely Gevra, Dipka and Rajmahal to 25, 20 and 17 Mty capacities respectively. Many other coal projects being planned by CIL are of 8 to 10 Mty capacity. These mines are being planned to go to depths beyond 100 m and quite a few would have ultimate depth in the range of 200 to 250 m, and stripping ratios of the order of 1:5. The lignite mines in Neyveli are working at a stripping ratio of 1:5 and have planned ultimate depth in the range of 120 to 130 m. Giral lignite mine in Rajasthan is working at a stripping ratio of 1:14 and Rajpardi and Khadisaliya lignite mines in Gujarat are operating at stripping ratio of 1:12 and 1:9.4. A large lignite mine in Kapurdi-Jalipa in Barmer district has been planned to go to 200 m depth from surface at a stripping ratio of 1:12(8).

The deeper a mine is or the more adverse its stripping ratio, the larger will be the size of the external overburden (OB) dumps. In case of mines working steeply dipping ore bodies or coal seams (e.g. Malanjkhand, Rampura-Agucha, Panna diamond mine, Navin Kunada and Jhingurdah coal mines etc.) the whole of the OB has to be accommodated outside the excavation requiring large area for external OB dumping. Already many mines are facing problems of land acquisition and it is expected that the problem would become more acute in the future. It would be beneficial to adopt a system of regional planning so that the void created by an earlier mine is utilised for OB dumping from a new mine during the initial period of opening up of the mine. The mining industry, in general, is reluctant to rehandle OB material in external OB dumps for economic reasons but in a few cases it has been planned to rehandle the material to fill the void created at the end of mining, and it is expected that the practice will become more widespread in future.

In the large deep mines of the future, both the external as well as the internal OB dumps will generally rise several tens of meters above the ground level, partly due to the swelling factor of the broken rocks and partly due to the need of maintaining large volume of voids in the central haul road and the face zone of an operating mine(9).

Precautionary measures are necessary to avoid danger of dump slides, for control of erosion and to make the high dumps merge with the surrounding land form by flattening of the dump slopes.

10. Disturbance to hydrologic regime

Large and deep opencast mines will have great impact on the hydrologic regime of the region. With deforestation over the mine leasehold and changes brought about in the watershed characteristics, water flow in many streams in mining regions have been known to have dwindled and some perennial streams have turned into seasonal streams and others have receded. The major hydrological impact of a large and deep opencast mine, however, is on the ground water regime of the region. The cone of depression caused by lowering of the water table by the mine excavation usually extends to a radius of 0.5 to 1.5 km depending upon the depth of the mine and the characteristic of the aquifers present in the area. The water seeping into the mine and collected in the mine sump is partly used up in the mine and the excess amount is discharged into the surface drainage system. The water used up in the mine for spraying on haul roads, conveyors, at loading and unloading points, bunkers etc. is lost by evaporation. A deep mine is likely to have longer haul roads requiring more spraying water. The water used for green belts and plantation areas are also lost by evapo-transpiration. A part of the water discharged into the surface drainage system seeps into the ground and partially replenishes the loss of ground water caused by mine seepage but the proportion is generally very low. Many areas of the country (as many as 350 blocks now and the number is steadily increasing) are faced with the problem of over exploitation of ground water resources resulting in alarming lowering of water table. Therefore a lot of care has to be taken in estimating the water need and the mines of future are likely to be subjected to a lot of constraints on water use and discharge. All mines would be required to have workshop effluent treatment plants with oil and grease traps, sewage treatment plants in the mine colonies and sedimentation ponds for mine discharge and OB dump and leasehold run-off. Large mines of future will have large sized tailing ponds for separation of solids and recycling of water. Adequate precautions have to be taken to ensure that surface water bodies and aquifers do not get polluted with tailing pond water and suitable monitoring system will be put in place to carry out Aquifer Vulnerability Test. The mines of future would routinely adopt water economy measures such as application of dust control chemicals on haul roads and drip water irrigation system in green belt and plantation areas. The mines may be required to recycle the treated effluents, carry out rain water harvesting and adopt measures for recharging of ground water.

The mine closure plans of present day deep open cast mines generally have a water body at the end of mining but in future the depth of the water body may be restricted by code of practice to, say, 30 m. In case of shallow opencast mines with little or no overburden, such as those of limestone, silica sand, stone etc., the depth of the mine seldom exceeds 30 to 40 m. There is no OB to fill the excavation at the end of mining and usually the whole of the excavation becomes a water body of moderate depth, a useful asset for the surrounding community. Some of the limestone deposits occur below agricultural land when a lot of top soil and alluvium becomes available in the course of mining. In such cases an alternative land use of the mined out land would be possible with proper planning i.e. converting a part of the mined land into agricultural land and the rest into a water body. This alternative would generate more employment opportunities and may be preferred in future. Another alternative possible use of the excavated space, be it of a deep mine or a shallow opencast mine, is for disposal of fly ash from nearby power stations, if any. By 2020, around 240 Mt of fly ash is likely to be generated every year and its disposal would be a major problem for the country.

11. Ground vibration from blasting

Blasting will continue to be an integral part of mining for a majority of the mines. As mines become larger and deeper requiring heavy blasting, more complaints relating to ground vibration causing damage to structures may be expected from surrounding villagers. Management of mines in future would have to follow a well designed blasting plan and have in place a transparent system of ground vibration monitoring. Application of 'Surface Miner' leads to elimination of blasting(10) and experience of 'Surface Miner' operation in limestone and coal mines in India over the last decade has shown that the equipment is not only environment friendly but in suitable cases results in cost reduction, product quality improvement and mineral conservation. Hence a much larger number of 'Surface Miners' are likely to be deployed in the Indian mining industry, eliminating ground vibration problems in such cases.

12. Top soil use and mined land reclamation

It is expected that separate winning of top soil and its proper utilisation would become a standard practice in the mining industry of future. On the land reclamation front, afforestation would continue as the favoured method in mines with ample OB such as the coal mines. However, it is expected that by 2020 A.D. the problems relating to vesting of legal land rights of mined out lands to the mining organisations would be sorted out and many mines would invest money in land reclamation and generate revenue from plantation activities. As the principle of 'scarcity rent' pushes up the price of crude oil, the economic benefit of planting oil seed producing plants such as 'Jatropa' on mined out lands would become evident. Alternatively the mining organisations may be able to use the newly created forests on the mined out areas and OB dumps as land for compensatory afforestation under the Forest Conservation Act 1980. As a further alternative some mines may find it profitable to convert the mined out land to good agricultural land, which then can be used as replacement land for farmers from whom land has to be acquired for future mines.

13. Land acquisition, Involuntary Displacement and Community Development

An expanding mining industry of the future will continue to need large parcels of land and will have to face the problems of land acquisition as of now. Hopefully the procedure will get simplified with time and experience, and codes drawn up to reduce the conflicts which have become very common and the trauma of involuntary displacement of the land oustees. A national resettlement and rehabilitation (R&R) policy with enough flexibility provided to the States to deal with differing situations (for example based on density of population, productivity and availability of land etc.) is expected to be in place. The World Bank practice of treating all displaced persons, irrespective of whether they own land or not, as eligible for R&R assistance would hopefully become the accepted norm in the mining industry. It is also expected that the mining industry, based on the experience of carrying out the Coal Sector Environmental and Social Mitigation Project (1997-2002) of World Bank and other similar projects, would be able to implement the income generation schemes for displaced persons with greater success than now.

The track record of the major mining companies for community development has been commendable(12, 13). It is expected that these activities will expand in future and a greater share of the revenue of the mining companies will be spent on such activities.

14. Special problems of hill top mining

Iron ore and bauxite deposits are generally found on hill top or hill sides and in or near forest areas. The main environmental concerns arise from deforestation, dumping of waste rock on hill slopes, construction of access roads on hill sides, silting of agricultural fields and drainage channels at the foot of the hill and difficulty of reclamation of the mined out area in case of iron ore mines. Bauxite deposits are generally of 6 to 20 m thickness range and capped by laterite and soil cover. Mining is generally done in discrete blocks so that a mined out block is filled with laterite and soil from the next mining block and reclamation by afforestation follows soon after mining. For the iron ore mines of future, improvement in waste dumping practice is expected so that the waste dumps are stabilized and progressively reclaimed. After mining the hill top benches are first graded by blasting and dozing and then reclaimed with vegetation before abandonment of the mine.

15. Underground mining

Currently 359 of the 556 coal mines in the country are underground mines and another 33 are of the mixed type having both underground and opencast workings(14). The average annual production from an underground coal mine at 0.18 Mt is much lower than the average annual production of 1.5 Mt from an opencast coal mine. A majority of the underground coal mines are loss making units and only limited investments are being made in opening of new underground coal mines or in expanding production from the existing ones. Of the 2482 working mines in the non-coal sector 113 mines of copper, gold, lead-zinc, chromite, manganese ore, soapstone and mica have underground workings(15). In the absence of discovery of new large size metallic deposits, there is little likelihood for expansion of the underground non-coal mining sector also. Surface subsidence is the main environmental problem of underground mining. However, the underground hard rock mines working steeply dipping ore bodies generally do not face the problem of subsidence as in case of coal mines with flat or moderately dipping coal seams. The coal mines follow guidelines of limiting strain values on the surface for protecting various kinds of structures and where necessary adopt hydraulic sand stowing or partial extraction. Many of the underground coal mines are also beset with problems of mine fire, often a legacy of past unscientific mining practice. Fires in old and abandoned coal mines have given rise to a number of coalfield fires in Jharia, Raniganj and Bokaro coalfields. There have been some success in blanketing and containing these fires during the last two decades but the challenge of extinguishing these fires still remain.

16. Disturbance to wildlife and conservation measures

Many mining projects are located near forests or have diverted forest land within its leasehold. If the forest patch is the home of some endangered and rare plants and animals or forms the migratory corridor for wild animals, the impact of mining can be very severe. Wildlife in forests near mining areas are affected by mining due to loss of habitat, influx of human population, noise and vibration created by operation of plants and machinery and blasting, diversion of nallahs and loss of water bodies, and increased vehicular traffic. The birds lose their nesting sites and feed sources from the loss of trees. These days the mining organisations working near forest areas are often required to carry out conservation measures aimed at avoiding situations leading to man-animal conflict during the operation of the mine. Where a migratory corridor is affected by mining, a replacement corridor is created by converting some shrub or sparsely vegetated jungles to dense one by planting of trees. In future more restrictions on mining near forest areas can be expected and the mining industry would have to be more sensitive to the needs of wildlife protection in the country.

17. Mine Closure

Mining is only an intermediate use of the land and a mine has to close once the mineable mineral deposit is exhausted. The 2003 amendment of the Mineral Conservation and Development Rules 1988 has made it mandatory for non-coal mines to formulate progressive mine closure plans as a component of mining plan as well as a final mine closure plan to be submitted to IBM for approval one year prior to the proposed closure of the mine. There is no statutory requirement of a mine closure plan for the coal sector as yet but the coal companies on their own are preparing a conceptual closure plan for inclusion in EMPs of new coal projects. It is expected that the statutory requirements underlying mine-site rehabilitation and decommissioning would become more stringent in future years and codes of practice for different mineral groups and site conditions would be developed to enable all stakeholders to have their interests considered during the mine closure. It is hoped that by 2020, the standard mining practice would be so designed that the last few years of mining activity in a leasehold would be focused on mine closure permitting the mine operator to adopt a 'walk away' solution at the end of mining leaving no danger for the community from past mining.

18. Monitoring and self-regulation of environmental management practices

At present the mining organisations have to carry out environmental monitoring and submit periodical returns to various statutory authorities such as the State Pollution Control Boards, Regional offices of the Ministry of Environment and Forests and Indian Bureau of Mines. Officers of these organisations sometimes visit the mines to check on the compliance of statutory conditions.

Many mining organisations have voluntarily decided to go for ISO 14001 certification which requires monitoring of environmental parameters and continual improvement of environmental indices through the adoption of an Environmental Management System (EMS). It is expected that most mining organisations in future would go for such accreditation and put an EMS in their mines.

Although some mining companies in the past have done unscientific mining and caused large scale environmental damage, most mining organisations these days are alive to the need of protecting the environment. But the public perception of mining as an agent for environmental damage continues to remain. The mining industry needs to show case its good work relating to environment such as planting many millions of trees and carrying out community development work in hundreds of villages located near the mines. The FIMI Publication 'Environment in non-coal mines'(July 2004) is a significant contribution in this regard and in future, the mining industry is likely to come out with more such documented reports to make the public aware of the good work done by the industry. The courts these days have been very active in matters relating to environment and many Public Interest Litigations (PIL) have been admitted against mining organisations. Judicial activism in environmental matters is likely to remain in future also. Independent audit of performance relating to environmental management may become a statutory requirement in future. Green Rating of industries(16) by an independent reputed organisation not only helps in letting the company know where it stands in comparison to other similar companies but also points out the ways by which the environmental management in the unit can be improved. The Green Rating Project carried out by Centre of Science and Environment (CSE) for the paper and pulp, and chlor-alkali industries have received wide acclaim. CSE is carrying out a GRP of the cement plants and limestone mines and plans to extend the technique to Power Stations in its next phase. It is expected that participation in such voluntary rating programmes would be one of the ways the mining industry would adopt in future to improve its environmental performance and instill public confidence.

19. Concluding Remarks

I have chosen a very large canvas for covering the topic of my lecture and to fit within the time slot I had to be selective in my choice of the minerals or the environmental impacts. In this way some important minerals and some of the environmental impacts have been left out from the ambit of the lecture. But the basic fact comes out that for sustaining the planned high growth rate of the Indian economy, the mining sector has to expand substantially. The growth will be especially high in the mining of coal, lignite, iron ore, bauxite and limestone.

The mining industry of future would lay greater emphasis on regional planning to reduce need of land for external OB dumps. It would give more importance to flattening the slopes of high OB dumps and hopefully, may get ownership of the mined out land to permit it to adopt various land reclamation measures in addition to that of afforestation. The mining industry of future would lay great emphasis on economy of water use, recycling of water from treatment plants and would be mindful of minimising the impact on ground water resources. It is expected that deployment of Surface Miner will greatly increase in future years. It is also expected that wherever mining will be carried out in or near forest areas, wildlife conservation measures would be adopted in co-operation with the forest department. The mining industry will follow a model code of R&R to tackle the problem of involuntary displacement. Mine closure planning will be given a lot of importance with involvement of all stakeholders. The practice of adopting ISO 14001 and voluntary participation in Green Rating or similar exercises would become more widespread.