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Environmental Concerns of Coal Mining – Broad View In Indian Context

Mining is an economic activity that consists of the extraction of potentially usable and non - renewable mineral resources from land or sea. It is one of the oldest industrial sector and its history has evolved with progress of human civilisation in different time periods at different places, all over the world. It is a key sector in society not only for providing essential raw materials for industrial development; but also for having the potential to bring economic and social development, in remote and poorly developed areas. Yet mining by its very nature, disturbs the land, air and water systems resulting in some negative impacts on environment and society. Thus, mining needs to be developed, managed and concluded in a suitable manner.

In India, as anywhere else in the world, most mining operations were carried out without concern, or even awareness, of the negative environmental impacts. The consequences of those inadequate practices are tangible nowadays, some of which can be witnessed in coalfield fires in our neighbourhood. While the economic benefits of the industry are as important today as they ever were, the

populace has become increasingly concerned about the impact that mining is having on the natural environment. As a result, more and more ongoing operations nowadays include adequate environmental practices as part of their mining activities that ensure not only safeguarding the environment, but also contributing to the local social and economic development.

The impacts of a mining operation commence right from exploration activities, extend through extraction and beneficiation, and may continue to post-closure. The potential environmental implications of these activities include impacts on surface water quality or hydrology, loss of natural habitats, resettlement, loss of cultural heritage or religious sites, affects visual aesthetics, noise pollution, loss of agricultural land or forestry resources, etc. Other negative aspects of the mining industry are of concern more to the workers in the industry than to the public at large. Dusts and noise, for example, are produced by mining activities and can cause serious health hazards to mine workers.

India is a premier country to make provisions for the protection and improvement of environment in its Constitution. By the 42nd amendment to the Constitution in 1976, provisions to this effect were incorporated in the Constitution of India. Article 48A enjoins the State to make endeavour for protection and improvement of the environment and for safeguarding the forest and wild life of the country. Article 51A (g) of the Constitution stipulates that it shall be the duty of every citizen of India 'to protect and improve the natural environment including forests, lakes, rivers and wildlife and to have compassion for living creatures'.

Coal is the key energy mineral in India, providing for more than 50% of commercial energy needs. 70% of the power generation is coal based and nearly 80% of the coal produced in the country is consumed by the power sector. With

limited oil and gas reserves in the country coal will continue to be the major contributor to the Energy Sector of the Country. The ongoing reform measures have helped to accelerate the pace of economic growth in country. Sustained liberalization process has provided numerous openings in the Indian economy, which is catching up with the developed countries. The results can be witnessed in development taking place all around and improving quality of life of the people. The annual GDP growth rate for past four years has been around 8% and is projected to reach 10% by the end of XI Plan period (i.e. by 2011-12).

About 95% of coal requirement is met by indigenous production and only a small quantity of low ash coal and metallurgical coal is being imported to meet the specific needs of steel and some other industries. However, for oil and gas, the bulk of demand (70%) is met through import. The situation for oil and gas is not going to be much different in future considering their limited reserves in the country.

In last 30 years, our coal production has increased almost four folds and crossed 400 million tonnes mark in 2005-06. The current estimates of coal demand in the terminal year of the next five year plan i.e. the Eleventh Five Year Plan indicate that the overall coal demand in 2011-12 is 731 million tonnes implying a compounded annual growth rate of 9.7 percent and the same is estimated to reach 1125 million tonnes by 2016-17. Correspondingly, the production potential estimated is 680 million tonnes in 2011-12 and 1055 million tonnes in 2016-17. A gap in supply position of about 51 million tonnes is envisaged in 2011-12 and some estimates even project the gap at 100 million tonnes.

Responding to the ground realities, Government has taken certain policy decisions to meet the challenges and ensure proper management of the coal supply-demand scenario. The major efforts aim towards encouragement to

captive mining for the sectors which consume almost 90% of our total coal production; adoption and furtherance of various Clean Coal Technologies; 100% FDI in coal mining to facilitate investment, offering of coal blocks to mine operators; allocation of coal blocks for Ultra Mega Power Projects etc.

To augment the production, Government has identified 148 captive coal blocks with over 30 billion tonnes of coal reserves for allocation to private/public sectors for specific end use. Out of these 123 blocks, with about 27 billion tonnes reserves have already been allotted. Besides these, 11 lignite blocks with about 800 million tonnes reserves have also been allotted. Recently, 81 more coal blocks with 20 billion tonnes reserves have also been offered under various routes.

However, like any other mining activity, mining of coal also disturb the balance of natural environment, which can extend well beyond the extent of mining areas. This happens partly due to mining process and partly to the composition of coal itself. The concern becomes more severe with production of such large quantities. It gets further amplified considering that this huge amount is going to be burnt somewhere by the end user.

The impact of mining is experienced on the following major heads which have been very well documented by several authors at various places.

Land Disturbance:

This can be in form of left out voids, formation of overburden dumps, ground subsidence, etc. which have further bearing on:

- local land use
- surface and ground water
- soils

- native vegetation
- wildlife populations.

Water Pollution:

Dust and Noise pollution: Dusts, for example, which are often hazardous, are produced by many mining activities. Noise, too, is a form of pollution and is of concern for those in the work environment.

Rehabilitation:

Methane Emissions:

Carbon dioxide Emissions:

In India, more than 80 % of coal is produced from open cast mines. But paradoxically they are considered '*bad boys*' of mining which is not justified. In a way though, impacts of opencast mines are more visible and considerable, proper post mining treatment can convert the mined out areas more productive with great value addition. This is being done the at many places in the world and in India also we have many mines where good reclamation work have been done. Thus, opencast operations can be considered as more environment friendly and more sustainable than underground mining, when we see the problems of old underground mines creating havoc in many localities due to subsidence and fire hazards.

Opencast method has the reputation for ruining the landscape by leaving heaps of almost sterile dumps. While the mine is in operation, this is a valid criticism, but once mining is complete, reclamation can start. Reclamation requires planning, and one of the first things that should happen when the mine is opened is to remove the topsoil and store it separately. Once reclamation starts, the dump can be filled back in the excavation, the surface graded and

the topsoil spread and seeded. In this way it is possible to restore the surface such that the prior existence of a mine becomes almost unnoticeable. The void left out by the mining may eventually fill with water and can be used to provide recreational facilities. Other potential use may be fisheries and water supply to local population and industries. Such water bodies can also act as a means to recharge underground water-table.

Huge overburden dumps, often contaminated with waste coal, spread across the horizon are formed as a result of opencast mine or of coal washing. The coal in such dumps may burn spontaneously and emit fumes and smoke. However, these heaps can be properly reclaimed and restored.

Underground mines cause land subsidence, which can have a severe impact on roads, water and gas pipelines, buildings, and water-bearing strata. Although, subsidence can occur during operation of underground mines, it poses a potential threat many years after the mine has been abandoned in case the pillars are left to support the overlying strata deteriorate and collapse. Ignorance coupled with violation of extant rules has led to manifold increase in unauthorised human settlement over the old abandoned mining areas specially in Jharia and Raniganj Coalfields. Even after these areas have been declared unsafe and hazardous repeatedly by DGMS (Director General of Mines Safety) and State authorities at various times, the controlling machinery have failed to contain further development of human habitat in the endangered areas. A thorough understanding of subsidence patterns in a particular region allows the effects of underground mining on the surface to be quantified. This ensures the

safe and maximum recovery of a coal resource, while providing protection to other land uses.

During mining operations, steps must be taken, by good planning and environmental management, to minimise effects of soil erosion, dust, noise and water pollution, and impacts on local biodiversity.

Mine reclamation activities are undertaken gradually - with the shaping and contouring of OB dumps, replacement of topsoil, seeding with grasses and planting of trees taking place on the mined-out areas and care is taken to relocate streams, wildlife, and other valuable resources. Plant species should be such that it suits local climate and benefits human society and wildlife. Reclaimed land can have many uses, including agriculture, forestry, wildlife habitation and recreation. In many areas of SECL plantation has been done to promote sericulture. Similar practices can be adopted elsewhere also.

Coal mining is only a temporary use of land, so it is vital that rehabilitation of land takes place once mining operations have ceased. In best practice, a detailed rehabilitation or reclamation plan is designed and approved for each coal mine, covering the period from the start of operations until well after mining has finished. Land reclamation is an integral part of modern mining operations around the world and the cost of rehabilitating the land once mining has ceased is factored into the mine's operating costs. The requirement of land for next

five years by coal companies is estimated to be around 800 sq. km comprising of both forest and non-forest land.

In USA Abandoned Mine Reclamation Act of 1990, requires mine operators to maintain certain environmental standards during mining, reclamation and measures to control land subsidence, and also imposes fees 35 cents per ton of coal mined by surface methods, 15 cents per ton mined underground to help pay the costs of reclaiming land and water resources affected by past mining operations. Similar practice can be tried in India as well.

Partnerships should be forged between the mining industry, government, civil society, environmental groups, local populace, financial community and the scientific communities. The mining industry should develop stronger skills to engage the affected communities in discussion on issues related with mining. These partnerships would enable the communities to realize the benefits from and to take advantage of the mine that would be in their area for many years. Local people should be trained for mining related jobs and communities prepared for subsequent use of the land when the mine is eventually closed. The strong community partnerships would also enable them to be aware of and prepare for dealing with environmental issues appropriately.

Methane (CH_4) is released from the coal seams and the surrounding strata during mining operations. Methane is a potent greenhouse gas which is formed as part of

the process of coal formation. It is estimated to account for 18% of the overall global warming effect arising from human activities. CO₂ is estimated to contribute 50% . Methane is 21 times more potent in its greenhouse effect than carbon dioxide, and methane is growing in the atmosphere at a faster rate than carbon dioxide (although off a lower base). All coal contains some methane. The deeper the mine, generally the higher is the amount of methane in the coal. As mining proceeds, the methane is released into the mine air and eventually discharged into the atmosphere. While coal is not the only source of methane emissions, (it contributes 8%) - agricultural activities are major emitters (Rice 11%, Oil &N. Gas 16%, Live Stock 32%, Solid Waste 13%, Waste Water 10%, Others 10%) methane from coal seams can be utilised rather than released to the atmosphere with a significant environmental benefit.

Coalbed methane, (CBM) is methane trapped within coal seams that have not, or will not, be mined. Coal mine methane, (CMM) is methane released from coal seams during coal mining. Methane is highly explosive and has to be drained during mining operations to keep working conditions safe. In active underground mines, large-scale ventilation systems move massive quantities of air through the mine, keeping the mine safe but also releasing methane into the atmosphere at very low concentrations. Some active and abandoned mines produce methane from degasification systems, also known as gas drainage systems, which use wells to recover methane. While improving safety in coal mines, the use of CMM improves the environmental

performance of a coal mining operation and can have a commercial benefit. Coal mine methane has a variety of uses, including onsite or off-site electricity production, use in industrial processes and as supplement fuel for coal fired boilers. Coalbed methane can be extracted by drilling into and mechanically fracturing un-worked coal seams. While the CBM is utilised, the coal itself remains intact for extraction.

There are many alternative technologies like coal bed methane, coal mine methane, underground coal gasification, coal liquefaction, etc. which can be of immense value for extracting energy from coal. The added advantage of these technologies is that these provide energy in a clean form and have lesser bearing on our environment, too. It is the right time that we focus our attention on development of these technologies in the country. A considerable work has already been done in area of CBM and we may see production of gas starting within a couple of years. In UCG and coal liquefaction areas many private entrepreneurs have shown keen interest. Government is also in the process of formulating necessary framework and guidelines to facilitate the development of these technologies in India.

When coal is burned as fuel, it gives off carbon dioxide (CO_2), the main greenhouse gas that is linked with global warming. Burning coal produce emissions, such as sulphur, nitrogen oxide (NO_x), and mercury, that can pollute the air and water. Sulphur mixes with oxygen to form sulphur dioxide (SO_2), which can affect trees and water when it

combines with moisture to produce acid rain. Emissions of nitrogen oxide cause smog, and also acid rain. Mercury that is released into the air eventually settles in water. The mercury in the water can undergo bio-magnification at different trophic levels and can be harmful to animals and people who consume them.

We are already aware of environmental implications of coal usage and utmost care must be taken to make the coal environment friendly at production centres as well as at consumer centres. The advent of Clean Coal Technology (CCT) is the outcome of the efforts being made towards that end. Now people are talking about zero emission from power plants integrated with Carbon sequestration facilities. The quick depletion of the non-renewable fossil-fuels may restrict their production potential which in turn may affect the sustainable development of national economy. Therefore it becomes imperative that we initiate measures to conserve our precious energy resources. This can be possible only with right planning for mining and deploying right technology. The losses and blockage of reserves should be reduced to minimum. By reducing the cost of mining we can win many coal deposits which are sometimes left un-worked on economic ground.

In future, environment regulations are going to become more stringent. Already use of coal having more than 34% ash is restricted for movement to more than 1000 km for consumption at power stations. As almost two third of coal reserves of India is high ash thermal coal, the need for washing such coal can not be overemphasised. The economic benefits of using

washed coal is slowly recognised by coal consumers and the private sector has come in a big way in this area and washing capacity of non coking coal has increased many folds in last 5 years. It is estimated that about 243 million tonnes of washed thermal coal is required to be supplied to comply with the environmental stipulations by the end of the Eleventh Plan as against the present washing capacity of about 100 million tonnes.

Similarly, on utilisation front power sector must come out with new designs of boilers for increasing thermal efficiency, utilising abundant reserves of high ash coal and maximising utilisation of fly ash in brick-making, cement and in other areas.

The interrelated nature of the social, health and environmental impacts of mining should be recognized by all the stake-holders and appropriate measures should be adopted at mitigating such impacts. In managing the ongoing environmental, social and health impacts of private and public sector mining operations, an Environmental Management System (EMS) should be developed, which should encompass the organizational structure, responsibilities, and procedural controls to ensure sound environmental and safety management.

The principles guiding development of environmental management should include the following:

- Development of rational and safe mining systems with minimum effect on environment. At the same time the environmental laws and mining activities

should complement each other to harness maximum available energy resources in the country to contribute towards providing the much needed energy security.

- Development of a regulatory framework and environmental, health and safety standards, that should take due account of accepted international practices.
- Development and Availability of cost effective technologies so that mining sector can finance the costs of compliance.

The challenges before the mining companies are to explore, extract and process (wash/beneficiate) coal with the least possible disruption to the environment. To meet these challenges, they should adopt a range of protective measures, including: sensitive treatment of the land during exploration; environmental and aesthetic management of land under development; environmentally sustainable production procedures during the mining and beneficiation processes; and decommissioning/closure and reclamation practices aimed at restoring the land.

Undoubtedly, different regions have various problems unique to them, but approach to tackle such problems will be common in most cases.

Steps in Environmental Planning for Mines:

Exploration stage:

- baseline environmental studies

Planning stage:

- select mining methods
- obtain initial approvals
- design OB dumps
- design wastewater systems
- make progressive mine closure plans

Production stage:

- monitor air, water and soil quality

- waste management
- maintain wastewater systems
- monitor coal stock, OB dumps

Mine closure:

- Fence mine and OB dumps
- demolish and remove structures
- complete cleanup
- continue monitoring water quality

In 2002, *The World Summit on Sustainable Development* (WSSD) emphasized the need for sound management of minerals and metals and for a truly global partnership to implement an integrated and strategically focussed approach to the environmental and social challenges for Sustainable Mineral Development. Coal Industry was called for to improve its environmental stewardship and to decrease energy and water demand. Governments were requested to foster regulatory regimes that promoted sustainable mineral development including developing economic policies that internalized the environmental costs of production. Environmental and social NGOs were expected to become partners with industry and governments in the transition to Sustainable Mineral Development.

It is important to balance concerns for the environment alongside the priorities of economic and social development. But the development that meets the needs of the present must not compromise the ability of future generations to meet their own needs. Environmental laws and modern technologies have greatly reduced coal's impact on the environment. Without proper care, mining can destroy land and pollute water. Today, restoring the land damaged by surface mining is an important part of the mining process. Because mining activities often come into contact with water resources, coal producers must also go to great efforts to prevent damage to ground and surface waters.

The challenge of the mining industry is to convince the Nation of it's worth that the benefits of mining outweigh the costs of disruption to the environment and livelihoods. However, uncontrolled environmental damage, whether a result of negligence, or human error, or from accidents can be far more costly to companies, communities and national economies than preventing environmental damage in the first place. The efforts made by the mining industry to provide a sustainable future for posterity is evident. But a lot remains to be done. There is still a wide gap between the best possible and what is being achieved. It should be our endeavour to bridge this gap which would much easier to do if every one of us understands the importance of clean sources of energy for effluent and cleaner future of our society.

THE END