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Research Paper

Detrimental Environmental Impact of Mining & Consequential Improvement – An Overview

Engineering

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G.Kumar

Professor& Head, Geology, BIT Sindri, P.O. Sindri Institute, Dhanbad – 828 123 Jharkhand, India

ABSTRACT

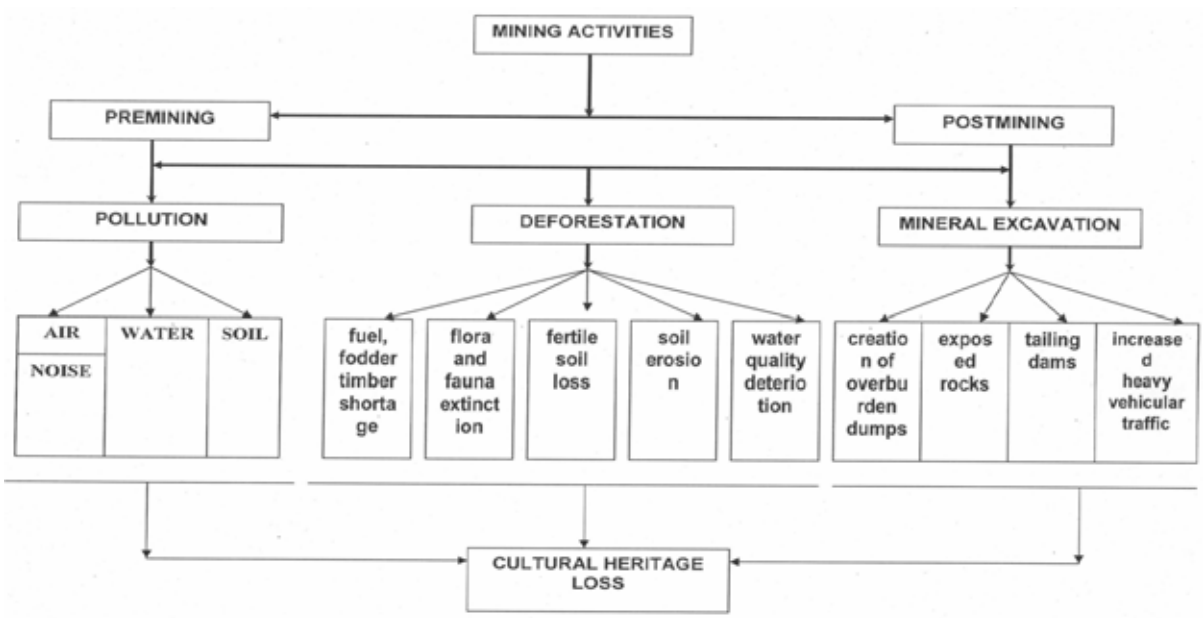
"Environment" has become one of the hot topic for discussion these days among most sections of the society. World over, great stress is being laid on a variety of environmental issues such as (i) Conservation and management, (ii) Pollution – effects of pollution on health of human being and other organisms, (iii) Solutions and remedies for pollution which are discussed and debated world over. India is the only country in the world where environment has been enshrined in the Constitution. Art. 48 (A) of our Constitution envisages protection, preservation and proper management of the natural wealth by every citizen.

The environmental impact of mining includes erosion, formation of sinkholes, loss of biodiversity, and contamination of soil, groundwater and surface water by chemicals from mining processes. Mining companies in some countries are required to follow environmental and rehabilitation codes, ensuring the area mined is returned to close to its original state. Some mining methods may have significant environmental and public health effects. Erosion of exposed hillsides, mine dumps, tailings dams and resultant siltation of drainages, creeks and rivers can significantly impact the surrounding areas. In areas of wilderness mining may cause destruction and disturbance of ecosystems and habitats, and in areas of farming it may disturb or destroy productive grazing and croplands. In urbanized environments mining may produce noise pollution, dust pollution and visual pollution.

In this paper, an attempt has been made to highlight pertinent environmental issues concerning adverse environmental impact of mining.

INTRODUCTION

The development of a country is dependent primarily on industries. Industries help in economic development of a nation, make way for better infra-structure and improve the socio-economic condition of the communities. But, at the same time, industrialization has brought together with it a gamut of problems – every stage is associated with some form of pollution: (i) release of effluents, (ii) gaseous emissions, (iii) foul smell, (iv) noise due to various production processes, (v) unhygienic working conditions are some of the problems witnessed by most industries. Minerals constitute the essential raw materials to sustain the present-day civilization. We need coal for energy, iron ore for steel, limestone for cement, bauxite for aluminum, phosphorite for fertilizers and similarly various other minerals for many essential requirements for the national economy. Minerals, however, are often found to occur in forest, hilly or tribal areas and mining of such mineral deposits have major effects on the physical and biological environment of the region, Hughes(1999). The key environmental challenges facing the mining industry are as follows (Fig. 1).



AIR POLLUTION

Air pollution in coal mines is mainly due to fugitive emission of particulate matter are gases, including methane, carbon monoxide, sulfur dioxide and oxides of nitrogen. The mining operations such as drilling, blasting, movement of the heavy earth moving machinery on haul roads, collection, transportation and handling of coal, and the screening sizing and segregation units are the major sources of such emissions.

Opencast mining is more severe an air pollution problem in comparison to underground mining. High levels of suspended particulate matter increase respiratory diseases such as chronic bronchitis and asthma cases while gaseous emissions contribute towards global warming besides causing health hazards to the exposed population. The uncontrolled dust not only creates serious health hazard but also affects the productivity through poor visibility, breakdown of equipment, increased maintenance cost and ultimately deteriorates the ambient air quality in and around the mining site (Kumar et. al. 2013). The dust can also pollute nearby

surface waters and stunt crop growth by shading and clogging

the pores of the plants. Besides polluting the environment, the generation of dust means the loss of fines, which act as road surface binders. Underground mine fires are also a major source of air pollution in some coalfields. High level of suspended particulate mater (SPM) increase respiratory diseases such as chronic bronchitis and asthma while gaseous emissions contribute to global warming.

WATER POLLUTION

The major source of water pollution in the coal mines is the carry over of the suspended solids in the drainage system in the mine stamp water and storm water drains. In some coalmines, acidic water is also found in the underground aquifers. In addition, waste water from the coal preparation plant and mine water are the other sources of water pollution (Chapple, 1999).

Mining can have adverse effects on surrounding surface and ground water if protective measures are not taken. The result can be unnaturally high concentrations of some chemicals, such as arsenic, sulfuric acid, and mercury over a significant area of surface or subsurface. Runoff of mere soil or rock debris -although non-toxic- also devastates the surrounding vegetation. The dumping of the runoff in surface waters or in forests is the worst option here. Submarine tailings disposal is regarded as a better option (if the soil is pumped to a great depth). Mere land storage and refilling of the mine after it has been depleted is even better, if no forests need to be cleared for the storage of the debris. There is potential for massive contamination of the area surrounding mines due to the various chemicals used in the mining process as well as the potentially damaging compounds and metals removed from the ground with the ore. Large amounts of water produced from mine drainage, mine cooling, aqueous extraction and other mining processes increases the potential for these chemicals to contaminate ground and surface water (Banerjee, 2004).

NOISE POLLUTION

The main sources of noise pollution are blasting, movement of heavy earth moving machinery, drilling and coal handling equipment. A cumulative effect of all mining activities produces enormous noise and vibrations in the mining area, which constitutes a source of disturbance. The availability of large diameter, high capacity pneumatic drills, blasting of hundreds of tonnes of explosive etc. are identified as noise prone activities. In pit crushing system with mobile crusher and large capacity materials handling plants are being installed to facilitate speedy handling of large quantities. All these activities are major sources of noise & vibrations in and around the mining complexes (Harvey, 2002).

The obvious implication of noise is, of course, the potential for noise-induced hearing loss. In addition, noise produces other health effects, influences work performance and makes communications more difficult. Besides, the fauna in the forests and other areas surrounding the mines/industrial complexes is also effected by noise and it has generally been believed that wildlife is more sensitive to noise and vibrations than the human beings.

IMPACT OF COAL MINE FIRES

A number of coal mines in the country are affected by fires leading to steady destruction of precious energy resource, (Singh, 2005). The reason for mine fires presumably involves the phenomenon of spontaneous heating through two interrelated processes viz., the oxygen coal interaction or oxidative process and the thermal process. If remains uncontrolled, the fire could spread furtherthrough interconnected pathways and fissures in the strata. It is estimated that about 10% of total national coal resources are in the fire-affected areas. Mine fires apart from direct losses due to burning of coal, the other associated hazards encountered are: i) gas poisoning, ii) difficult geo-mining conditions, iii) sterilization of coal, iv) hindrance to production v) explosions, vi) damage to structure and adjacent properties, etc**.**

SOLID WASTE

The major solid waste in a coal mine is the overburden, segregation of the stones in the coal handling plants and coal breeze also contribute to the solid waste generation. The overburden to coal ratio in open cast mining is about $2m^3$/ton of coal. Other problems associated with coal mining are overburden, subsidence management; underground mine fire abatement land degradation during mining industry and its reclamation and compensatory re-forestation. The mined areas are back-filled and then rehabilitated for the development of vegetation. The external dump area presents a sterile appearance, unless rehabilitated. Vegetative rehabilitation of these dumps prevents erosion and improves aesthetics, (Douglas & Lawson, 2000).

HEALTH AND SAFETY MANAGEMENT

Unlike the manufacturing industries, the mining industries are more vulnerable to health of workforce and their safety. Even the adoption of safe practices in mining activities is of utmost importance. Therefore, efforts need to be made to bring the areas of high risks down to acceptable risk levels by introducing the concept of risk assessment and safety management plans. The basic purpose of health and safety management is to create a working mechanism involving all concerned at every level by which dangerous events and accidents may be prevented.

ENVIRONMENTAL MEASURES TO BE ADOPTED

1) Air pollution control measures:
(a) Water spraying on haul roads by mobile and fixed sprinkles.
(b) Dust extractors in the coal handling plants and drilling equipment.
(c) Black topping of service roads.
(d) Massive plantation on the road sides and over burden dumps and other empty lands.
(e) Dust masks for the equipment operators.

2) Water pollution control measures:

(a) Effluent treatment plant (ETP) should be installed in the down flow line of the mining area as well as the mine discharges so that effluents meet the prescribed standard. As far as possible, the mines should reach "zero discharge".
(b) Sewage treatment plants (STP). STPs should be constructed to take care of domestic discharge of the mine colonies.

3) Noise and Ground Vibration control Measures:

Following actions should be adopted to keep the noise level within the prescribed limit in day and night time.

(a) Use of controlled blasting technique.
(b) Green belts around the colonies and mine areas.
(c) Proper maintenance of heavy Earth Moving Machinery.
(d) Issue of earmuffs to the excavation work force.

REHABILITATION ACTION PLAN (RAP)

Includes shifting of villagers affected by mining Resettlement and rehabilitation of the project affected families by giving a plot of land in developed resettlement sites.or lump sum package to settle at place of their choice. Villages falling within 1 kilometer area of the leasehold of the mines should also be considered. This includes:

(1) Development of community infrastructure like school building, Community Hall, Dispensary building, village roads, wells and tube wells.
(2) Community activities like MahilaMandal, Youth Club, Sports and Cultural program.
(3) Training and capacity building, self employment and Non-formed Education.

RECLAMATION PRINCIPLES

The areas affected by mining should be returned to a safe and production condition through reclamation. The process of reclamation should be on ongoing activity throughout the life of the mine operation. The reclamation principle can only be translated into action by appropriate technology which may include re-contouring and re-vegetation of degraded land surfaces. Contaminant of toxic waste and prevention of soil erosion and acid drainage are other components.

A participatory management for care and maintenance of the reclaimed area may ensure a process of benefit sharing specially from the forest, that are to be grown as a major work component of reclamation plan. Area rich in vegetation would match the existing environment. It is well known that trees absorb CO_2, contribute O_2, purify the air conserve the soil and prevent erosion and add to the utilization of slope.

REDUCING MINING'S ENVIRONMENTAL IMPACTS

- **There are a number of ways to reduce the environmental impacts of mining, including:**
- Reducing the consumption of minerals
- The efficiency of manufacturing processes can be increased to reduce the amount of new minerals required
- Substitution of other materials and processes with more environmentally friendly materials and processes
- Using recycled materials instead of mined materials
- Improving environmental performance at mines

ADOPTION OF SUSTAINABLE MINING

Key players in the global mining industry are also taking steps to promote sustainable mining (Sampat, 2003). Principles and performance elements under the banner Towards Sustainable Mining (TSM) cover six criteria as mentioned below :

1. Tailings Management
2. Energy and Greenhouse Gas Emissions Management
3. Aboriginal and Community Outreach
4. Crisis Management Planning
5. Safety and Health
6. Biodiversity Conservation

The International Council on Mining and Metals also works to improve sustainable development performance in the global mining and metals industry.

- Legislation and regulations to reduce environmental impacts can be enacted and enforced
- Cleaning up abandoned mine sites
- Economic measures

AN OVERVIEW OF THE INTERNATIONAL ENVIRONMENTAL AGENDA

Not only is the environmental agenda moving, but it is moving fast. The following are the major environmental issues for mining:

1. Destruction of habitat and biodiversity at the mine site.
2. Ecosystem/habitat/biodiversity protection in adjacent land.
3. Landscape/visual impact/loss of land use.
4. Mine waste/ tailings disposal.
5. Abandoned equipment, solid waste, sewage
6. Air emissions.
7. Dust
8. Climate change
9. Energy consumption
10. Siltation and changes in rivers regimes.
11. Effluent discharges.
12. Ground water alteration or contamination
13. Public health and urban settlement issues around mines etc.

The above issues do not appear from nowhere. The environmental agenda can not be seen in isolation from technical and socio-economic trends.

OBLIGATIONS UNDER INTERNATIONAL CONVENTIONS

In recent years, several international conventions have been adopted by governments under the auspices of the United Nations. States have the sovereign right to ratify a convention or to decline to ratify it. It is imperative for all countries to participate fully in negotiations prior to the finalization of conventions, involving all national stakeholders in the process of setting national policy as it is far easier to change a convention before it is signed than afterwards.

Some of the important conventions and protocols that have affected and will continue to affect the mining industry are given in Table 1. :

Table 1.Important Conventions & Protocols Affecting Mineral Inudstry.

Instrument	Impact on mining industry
World Heritage Convention, 1972	Affects permission to mine if there is any negative potential impact natural and cultural values.
Montreal Protocol, 1987	Fire protection technology affected specially in coal mining; changed refrigeration practices – CFCs leading to ozone depletion.
Biodiversity Convention, 1992	Affects access to land, because it addresses endangered ecosystems.
Kyoto Protocol, 1997 (Climate change)	Likely to lead to energy price changes, control on the release of carbon dioxide, methane and other greenhouse gases may affect the coal market.

Kyoto Protocol also has significant implications for the mining industry. Several countries have taken measures which seek to reduce electricity consumption, to reduce carbon-dioxide emission or to decrease reliance on coal.

CONCLUSIONS

Karl Marx long ago observed "Human Projects" that ignore the great laws of Nature brings only disaster". The cobra poison can be therapeutic, if we master the curative process. The rich out of greed and the poor out of need have been recklessly plundering the Earth's assets. There is now a deep anxiety of what have become essentials to our way of living, indeed even to life. The key production and control practices that would lead to compliance with emissions and guidelines can be summarized as follows:

1. Restoration and rehabilitation of disturbed areas.
2. Minimization of land subsidence.
3. Water management for operations and post closure conditions.
4. Long term geotechnical and geochemical stability of waste piles.
5. Restoration of acceptable long term surface water and ground water flow patterns.

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REFERENCE

Banerjee, S.P. (2004), Mineral Availability and Environmental Challenges-A Vision 2020 Statement, Prof. S.K.Bose Memorial Lecture, ISMines, Dhanbad, Nov. 2004. | | Chapple, S. (1999). The Environment Protection & Biodiversity Conservation Act (Cth): One Year Later", Environmental and Planning Law Journal 18(6), pp 523-539. | | Douglas, I. & Lawson, N. (2000). An earth science approach to assessing the disturbance of the Earth's surface by mining, 2000, School of Geography, the Univ. of Manchester. | | Harvey, B.E. (2002). New Competencies in Mining: Rio Tinto's experience, Melbourne, Rio Tinto. May 2002. | Hughes, L. (1999). Environmental Impact Assessment in the Environment Protection & Biodiversity Act 1999, Environmental and Planning Law Journal 16(5), pp 441-467. | | Kumar G. Singh, S.K., Sinha, B.K., Murari, K., Prasad, S.K., Pandey V, & Om Prakash (2013). " Air Environment Associated with Coal Mining Activity : A Case Study. Int. J of Chem Sc. 11 (1), 2013, 159 - 176. | | Sampat, P. (2003). Scrapping Mining Dependence, in G Gardner et al (eds.) State of the World 2003: A Worldwatch Institute Report on Progress Towards a Sustainable Society, Earthscan, London, pp 110-129. | | Singh, G (2005). Regional Environmental and Social Challenges facing Coal Industry. The Coal Summit, Indian Energy Forum, Coal Forumand MGMI, 19-20, Oct. 2005. | | | 1. http://almanac.webdata.com/economics/economic60.htm | 2. http://minerals.usgs.gov/minerals/pubs/country/ | 3. http://www.nswmin.com.au/minerals/coal-sustainable-future.pdf |