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Mining industry and environment

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ABSTRACT

This paper accounts for the escalating problems associated with mining practices. The mining activities cannot be stopped as they retain the vital sector of the Indian economy and an important share to power generation and other industries and sections. The pollution caused by these industries could not be ignored as it is one of the major global problems to be resolved.

Keywords— *Mining practices, Mining activities, Global problem*

1. INTRODUCTION

Presently, coal contributes around 67% of electricity generated in India. Mining is the second largest industry and is a vital sector of the Indian economy [1]. The total share of coal for power generation in India is almost 75 % of available sources and the scenario will continue to remain the same in future [2]. After agriculture, it contributes significantly to the national income. According to the International energy agency, the proven reserves of coal are around 909 billion tonnes, which could sustain at the current production rate for 155 years. China, which already has many of the world's most polluted cities, was built about two coal-fired plants every week, in 2007. Coal is the fastest growing fossil fuel and its large reserves would make it a popular candidate to meet the energy demand of the global community, short of global warming concerns and other pollutants [3]. The present assessment of coal resources in India is around 253 billion tone or coal seams of thickness 0.9 m and above and up to 1200 m depth from surface, out of which about 96 bn tones are proved reserves, while the indicated and inferred resources are about 120 and 38 billion tones respectively. The quantity of non-coking coal is 214.85 bn tn, and that of high sulphur coal is 0.91 bn ton only [4].

Mining is one of those activities that really connect issues relating to people, development and environment. The negative impact of mining on health, land, water, air, plants and animals, and other aspects of society can be reduced by careful planning and implementation of mining activities. It is essential to strike a balance between mineral developments on the one hand and restoration of the environment on the other [7].

We usually give coal the stink eye for the ways it harms the earth's surface when it is extracted, and the way it harms the earth's systems when it is burned. But we also need to hone in on the way coal harms our fresh water supplies. Between 800 and 3,000 gallons of water are used to extract, process and dispose of each ton of coal. with 1 billion tons of coal used per year in the US, that equates to as much as 75 trillion gallons of water wasted on dirty energy each year. Circle of Blue has put these stats and many other jaw-dropping figures into a compelling info graphic. In both measurements of withdrawal and consumption of coal is at the top of the charts. According to mining industry data, companies use 800-3000 gallons of water to mine and process and transport one ton of coal. According to the US Geological Survey, 410 billion gallons of water are withdrawn from rivers, lakes, streams, and aquifer each day in the U.S. About half of that -- 200 billion gallons daily -- is withdrawn for cooling power plants, mostly coal-fired power plants, which burn 1 billion tons of coal annually. Two hundred billion gallons per day X 365 = 73 trillion gallons withdrawn by power plants each year. The USGS estimates that thermal cooling for power plants withdraws 55 trillion to 75 trillion gallons per year, or roughly equivalent to the torrent of water that pours over Niagara Falls in five months [8].

2. MINING PRACTICES: OPEN CAST and UNDERGROUND MINING

The process of excavation of minerals of economic value from the earth's crust is called Mining. The mines are classified as (1) Open cast mining or Surface mining (2) Underground mining. If the excavation is operated from the surface it is called an open cast mining, whereas if the excavation constitutes human entry driven below the surface it is called as underground mining [5]. In particular opencast mining has been the cause of more severe environmental damage as compared to underground mining. As opencast mining contributes around 65% of the total production of minerals the danger possessed by it is much alarming and part of concern [6].Persistently declining coal production from underground coal mines and the trend of their contribution to total coal

production, which is presently at about 11% only, are issues of serious concern for the Indian coal industry. The land use pattern is changing fast with growing demand for settlement, mining and industrial activities [3] Opencast mining is more preferred due to lower mining cost, easier supervision, larger mechanical appliances, better working conditions with respect to light and air, safer working, more convenient and more efficient use of explosives and larger production and less skilled workers are required for the operation. While counting on the disadvantages the limitation to moderate depths and removal of a large amount of overburden along with exposure of workers to polluted weather. Opencast mining contributes a major share of 75% of minerals all over the world. Important minerals like iron ore, bauxite, dolomite, gypsum, magnetite are exclusively produced by this method. Continuous surface mining could be a smart alternative as it is cost effective for a broader range of mines [10]. The main problem encountered during underground mining is acid mine drainage. It is cost effective but requires much supervision and skill.

Most of the mineral-rich nations are now in a hurry to exploit their natural resources to generate wealth. These countries are giving priority for the extraction of their natural resources for the nation's development. Particularly underdeveloped countries and developing countries are losing their natural resources at very cheaper rates. On the other hand indiscriminate mining creating environmental problems to these nations. Another fact is that our policy makers and Government are ignoring this truth [9].

Mining is an ancient industry that plays a vital and significant role in the process of economic development of the country. But as the time progresses the mineral reserves get depleted and subsequently, the mines are closed down. Mining during its entire life cycle brings certain environmental and socio-economic changes in the areas surrounding the mines, these changes can be both beneficial and damaging, with respect to the local population [11]. Like all other industries, mining corporations need water to make bare rock give up its valuable minerals. Mining water uses its water for extraction of minerals that may be in the form of such solids as coal, iron, sand and gravel, such liquids as crude petroleum and such gases as Natural gas. The category includes quarrying, milling, reinjected extracted water for secondary oil recovery and other operations associated with mining activities. Mining population are facing acute shortage of potable water supply. It reveals that there is an acute need to supply potable water and to meet the agricultural water demand in the region. On the one hand, millions of gallons of mine water are being pumped out in the area and wasted. On the other hand, huge investment is being incurred for the identification and collection of raw water sources and for their treatment. The possibility of reuse of available mine water needs a thorough investigation to fulfil the raw water demand in the area which can also result in cost saving and maintaining water balance in the region. The national policy 1987/2002 emphasizes the need to augment the water availability from such sources and to meet various water demands of the local populace. Mining and associated Industrial activities in and around the mining areas lead to an acute shortage of potable water. These mining activities lead to water scarcity and pollute the natural resources too due to no precautious hands. It's an alarming situation as clean water is one of the basic need of society. 80% of the diseases in the world are water-related and hundreds of millions of people suffer from polluted water as per the WHO estimate [12].

Disposal of mine wastewater is a world-wide problem occurring wherever coal and gold mines, as well as old underground workings, are found. There are, of course, different types of water emanating from mines, depending largely on the geological properties of the coal, gold ore and other geological material with which water comes into contact. Such water could result in salinization of soils, rivers, dams and catchment areas if freely discharged into the natural environment. Current measures to prevent pollution of the environment include (i) prevention of ingress of water into the working by grading the surface area around the mine or building channels to collect and divert storm water; (ii) establishment of vegetation on tailing dumps and dam surfaces to prevent erosion, reduce the quantity and improve the quality of rainfall run-off from dumpsites; (iii) storage of mine water in evaporation areas; (iv) recycling of water from tailing dams through gold-recovery plants; and (v) utilization of mine water for cooling and by selected industries which can tolerate low quality water [13]. In several mines, acid mine drainage is treated with hydrated lime Ca $(OH)_2$ in order to neutralize acidity. Most of the resulting $CaSO_4$ is precipitated in sedimentation basins, but the liquid effluent is saline and gypsiferous. This wastewater is then used for dust alleviation on gravel roads and for irrigation of lawns.

The coal fields of the Eastern Highveld region of South Africa underlie one of the most important high-potential agricultural areas in the country. This is of particular significance when viewed against the fact that South Africa has a very low percentage of arable land, of which only a third (4.5 million ha) is regarded as being of high potential. In addition, South Africa has low and variable rainfall and 66% of the country is classified as semi-arid to arid. In view of the steadily increasing population, it is vital that agricultural land is maintained and effectively utilized. It is estimated that, in the absence of any coal mining and related activities, the sulphate concentration would have been as low as 20-40 mg/*l*. High salinity in surface water limits the use of water and introduces indirect costs in the use of the water further downstream. Pollution of surface water can be prevented by collecting and treating excess mine water to a quality where it could be re-used without restriction (Clean water 2020 Initiative) [14]. The demand for coal in India is expected to increase rapidly in future dominated mainly by the power sector. Majority of this coal is produced from opencast mines. The increasing trend of opencast mining along with the adaptation of large scale mechanization leads to the release of a huge quantity of dust and gaseous pollutants which affect work zone air environment [15].

Opencast coal mines are becoming more and more numerous across the world and it is estimated that shortly 50% of world production will be extracted from opencast or shallow mines (Australia 50%, USA 60% and Canada more than 80%). Around 50% of total dust is released during journey time on an unpaved haul road, while 25% is released during loading and unloading. The maximum concentration of coal particulates generally occurs during winter season and minimum in the rainy season.

Underground coal mines produce large volumes of water as part of Mining Operations. Federal regulations require that coal mines treat this water prior to disposing of it. Since greenhouses are large consumers of water, it is possible that greenhouses could use some of the CMW. The primary factor impacting the economics of using CMW in a greenhouse would be whether the water would require additional treatment prior to use in a greenhouse, and the cost apportionment agreed to by both parties. Land

degradation is severe in case of the opencast mining operation by creating huge dumps and deep voids result in drastic alteration of surface topography and visual aesthetics of the area. Mine degraded lands are manmade habitat, devoid of any soil structure and horizon, unbalance pH, poor nutrient conditions and sometimes devoid of nutrients, low moisture and compacted, high rock and gravel portions, elevated metal concentrations and biologically impoverished conditions. All these factors are responsible for the limitation of plant growth rather allowed specific tree species to grow on these lands. These habitats are restored by planting selected tree species mostly belongs to the leguminous family, Characterized by nitrogen fixation capability [16]. These species in long run improves the overall fertility of mine soils by enhancing the litter accumulation and organic matter, creates microhabitat for microscopic flora and fauna and ultimately delicate balanced ecosystem is developed on the mine soils[17]. Due to underground mining, though, the impact on environment and forest is comparatively less than opencast mining, the underground projects also do need forest clearance if they fall under forest cover.

The main use of water is in direct human consumption, in agriculture and industries. The mining industry requires water in every step of its operation. To improve the blast furnace efficiency and calorific value, coal is washed in coal beneficiation plant in water. Dust is the problem in mines, which is produced by mining activities like drilling, blasting, loading, hauling etc. Sometimes coal dust becomes hazardous as it may cause explosion also. Water is the most economical and easy mode of suppression of dust. In hydraulic mining, method water is used to break the coal masses and broken coal is transported by water from the face [18].

The mining industry plays a vital and major role in the economic development of the nation. But at the same time, it directly or indirectly contributes to the problem of air pollution. The major source of air pollution problem in a mining area is the presence of coal, soil or rock dust. A large amount of dust is produced due to blasting, hauling of overburden, coal or minerals etc. A prolonged exposure to air borne dust may cause damage to lung tissues of the miners which may further lead to pneumoconiosis or black lung disease. The air borne dust produced during mining operations of various types such as fugitive dust, nuisance dust, inhalable dust, respirable dust and total suspended particulates. Fine dust is physiologically more hazardous because of its large exposed surface area and chemical activeness. The maximum tissue damage is caused by the dust of 5 microns or lesser size since particles reach the alveoli of the lung. The increasing trend of opencast mining leads to the release of a huge amount of air borne dust. Thus dust generation and its dispersion have been found to be a major concern in opencast mining [19].

Mining invariably considered as an environmentally unfriendly activities. Air pollution continues to increase by mining industries with the consequences affecting growing numbers of people and ultimately the global environment. The effects of pollution manifest themselves in deteriorating air quality around the mining areas, resulting in increased cases of respiratory illness and rain and the increasing global threat to climate change. The effect of air pollution is aesthetics, economics, viability, safety, personal discomfort and health. The aesthetic effect includes loss of clarity of the atmosphere due to the presence of particulate matter and the presence of objectional gases. Economic losses attribute to air pollution around mining areas, damage to vegetation and crops resulting from exposure to concentration of gases such as NO_X, SO_2, and deteriorating of exposed material by the variety of air pollutants material deterioration include corrosion of metals by SO_2, weathering of stone by acidic mist, personal discomfort is associated with eye irritation and respiratory difficulties from a variety of air pollutants [20].

Employment in industries that support mining, including manufacturing, engineering and environmental and geological consultants, accounts for about 5 million jobs. Mining is necessary for nations to have adequate and dependable supplies of mineral and materials to meet their economic and defence needs at acceptable environmental, energy and economic costs. There has been a growing awareness in the country about environmental hazards due to mining. Stopping mining of necessary natural resources, however, is not a solution to this problem. This is where the true application of Science and Technology and play an effective role. If both the ministry of mines and the Ministry of Forests and Environment comes out with an amicable mining systematic s without much destructing the environment, the mining can be taken up harmoniously without much affecting the environment. The record of water level data is an important link for the planned groundwater exploitation of any terrain and in the absence of such data planning and design of a good field gets handicapped to a great extent. Although the water table levels vary considerably in various mining sections, the aquifer characteristics within the basement rocks are typically suitable for water recharge. Ground water is an essential natural resource and is an important source of water supply for drinking, irrigation and industrial purposes. Coal continues to be the prime source of energy of the country. Majority of Indian coal resources spread over the states of Andhra Pradesh, Assam, Chattisgarh, Jharkhand, Madhya Pradesh, Maharashtra, Meghalaya, Orissa and West Bengal and few other states, they account for a total reserve of 257.38 billion tones (as on 1.4.2008).coal production projections in XI plan period shows CIL to produce 520.50 million tones and 160 million tones by other producers. CIL targets have been revised to 600 million tones for the 11^{th} plan and set a new high of 800 million tone target for the 12^{th}plan. Opencast mining creates air pollution problem not only within the mining premises but also in surrounding residential area affecting abundant air quality. High level of suspended particulate matter increases respiratory diseases such as chronic bronchitis, asthama etc. while gaseous emission contributes towards global warming [21, 22].

3. ESCALATING PROBLEMS IN MINING ENVIRONMENT

The environmental impact s of mining activities may have short-term as well as long term implications. Environmental degradation in the mining area has become a major problem. To develop environmental protection strategies a clear understanding of the relationship between the environmental variables and availability of natural resource of the mine area is needed. Effective planning of natural resources depends upon timely and accurate information regarding existing land use/land cover pattern, spatial distribution and changes in the area. My water management is a vital part which needs to be considered early during my planning. One of the main problems in the mining industry is acid mine drainage, which causes a severe threat to the receiving watercourses and river catchments. Mining method must be improved to improve environmental conditions and control pollution. A large amount of overburden is removed and dumped in the valley in case of hilly areas. All these materials are to be tested for their use and see that no waste is left. The mining operations like drilling, blasting, crushing and other associated activities are carried out

in underground and opencast mines. Mining operations damage the environment and ecology to an unacceptable degree unless carefully planned and controlled. The rapid, unchecked and sometimes biased activities result in air, water and noise pollution. Land degradation, health hazards, loss of forest wealth and agricultural land, drying of wells, rehabilitation problems leading to large scale environmental deterioration [22]. It is calculated that, together with oil prospecting, mining is threatening 38% of the last stretches of the World's primary forests.

The demand for water is increasing continuously in the world. The amount of available water is reducing rapidly due to water pollution. Many countries are suffering from water deficiency. About 1.2 billion people in the world cannot drink clean water, and 5-10 million people die because of water-borne diseases. Two-thirds of the world population will face this problem by 2050. Australia is classified as a water deficient country, some areas suffer from this water shortage, and the supply of water mainly depends on rain. The desalination of seawater was developed in the 1960s to solve the water shortage. The amount of water in the world is estimated to be about 1.38 trillion m^3, but 97.5% is brine. Desalination has been developed to turn salt water into fresh water. But these methods have some advantages and disadvantages. The disadvantage of the evaporation method is that the energy cost is very expensive. Electro sorption can be an alternative option for desalination. But, it is essential to find another option for water source which will be cost effective, affordable and could be used for long term. Proper functioning of the biological systems is affected both by excess as well as deficiency of ionic characteristics of drinking water, as may cause a number of disorders in aquatic life and in turn the humans(116). Hence the measurement of ionic characteristics in water quality determines the source contribution of cations and anions in the form of dissolved solids in water resources like a river [23].

4. CONCLUSION

Mining can also affect local water and air quality. With the removal of overburden, runoff can become contaminated, more acidic, and more turbid. Erosion within the mined areas can be rapid if the soil is not recovered and reforested, the removal of vegetation can then bring about loss of flora and fauna, destruction of wildlife habitat, a possible spread of plant diseases, increased soil erosion, changes in weather conditions, dust and a possible need for runoff water treatment. In opencast or surface mining, the areas cleared of vegetation may disrupt the landscape and produce a negative visual impact [24].

Millions of gallons of mine water are being discharged daily from underground coal mines. This valuable water resource of acceptable quality becomes contaminated with various domestic and industrial trade effluents and consequently is just wasted while putting on an enormous energy cost burden on the underground mines. The water available from the various sources may, or may not, contain impurities. During Underground mining, lots of water which is present inside the earth's crust is released by mining and forms mine water, which when pumped out becomes contaminated with different industrial effluents and loses its acceptable value. Further costs are incurred on the abstraction of water from adjoining water bodies containing this water and also additional costs are required for treatment to meet the water quality objective criteria. The National Water Policy, 1987, emphasizes the need to augment the water availability to meet various demands from such sources [25]. Open cast coal mines deal with a considerable amount of topsoil. A good mining practice speaks for the scrapping of the top soil with small excavators before excavating the overburden and stores it in a scientific manner so that biotic properties are not lost.

Depending on the water availability and quality, it may be re-used for process applications on site such as make-up water, dust suppression or mill operations, grinding, leaching, and steam generation. Since more than 70% of all pollutants from the mining industry are emitted into the water, the removal of these contaminants prior to discharge is receiving significant attention. It is critical to avoid the discharge of toxic components into the environment. Because of this, regional discharge requirements are becoming more stringent, while non-compliance is being penalized more frequently and more heavily. Coal use impacts water at many points in its lifecycle, including direct and indirect water use and pollution at the mine site and at the power plant. In the United States, data on coal power plants‟ water use are well established, while water impacts from upstream activities like mining and improper mine closure are more challenging to predict [26].

Globally and domestically, coal is a major energy resource that creates known environmental problems. In particular, mining and using coal has impacts on water resources at many points throughout coal's lifecycle. Concerns about long-term water contamination are likely to increase as more, often lower grade coal is mined. The large quantities withdrew for power station cooling justifiably attract considerable analysis. Not only can power station cooling withdraw and consume large amounts of freshwater, but it also creates thermal pollution where the water is returned. This temperature increase lowers dissolved oxygen levels, can contribute to algal blooms, and can kill fish [26]. Additionally, fish, larvae, and other organisms can be impinged (caught against water intake screens) or entrained (taken into the cooling water circulation) by some plant cooling system configurations [27]. Wastes generated at the plant in the form of ash or Flue Gas Desulfurizer (FGD) waste, known collectively as Coal Combustion Waste (CCW), are often toxic and stored near water resources. Toxics like heavy metals can leach out of poorly controlled piles into storm runoff or leak from disposal sites into aquatic habitat and valued freshwater resources. The impacts of coal-fired power plants on water resources, including impacts on ecosystems requiring water, are relatively well understood in general if not in specific. By knowing a power plant's design, efficiency, size, cooling system, pollution control systems, waste disposal methods, and water source, one can relatively accurately predict water withdrawals, consumption, and contamination risks. This predictability is less true for upstream activities related to coal use: specifically, the impacts of mining on water resources are widely variable and difficult to generalize. Trends associated with mining region, mine type (surface or underground), and mine design are clearly visible, but the combination of coal's inherently heterogeneous nature and the variability of water resources makes impact calculation nearly impossible for a broad region. For example, coal seams are often found within an aquifer or below a water table, and the background quality of that water might not well known. Furthermore, some of the gravest impacts of coal mining on water resources are accidental and very long term, related to poor mine planning or inadequate geological knowledge Acid Mine Drainage (AMD) resulting from continuous reaction of sulfur with oxygen and water can be generated indefinitely, especially with a moving water table: some sites in the United Kingdom host AMD sources from

Roman times [28]. Impacts are site-specific. Despite the additional challenges of qualitatively and quantitatively analyzing mining impacts on water quality and quantity, these impacts are important and need to be accounted if we are to make the most environmentally protective energy choices possible. A full assessment of coal's lifecycle water impacts requires attention to water uses upstream of the power plant. In the mining of mineral resources, large volumes of mine water are generated with adverse effects on the already scarce water resources. It is an essential step for every industry to a step back and thinks about the reconstruction of the destroyed environment in today's alarming scenario.

A country's economy stands on industrial development but society can be served and saved better by conservation of the environment. Various rules and regulations are to be implemented and actions to be taken against environment destroyers. The World will be beautiful when we the people on Earth will respect and care for natural resources and environment.

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