

ENVIRONMENTAL IMPACTS OF MINING AND PROCESSING OF MINERALS: A REVIEW

Kamod K Rathore*

*Centre for Climate Change and Water Research, Suresh Gyan Vihar University, Jaipur

*Email- kamod.59720@mygyanvihar.com

ABSTRACT

Every coin has its two aspects similarly mining and its processing industries also have two aspects, the positive aspect of mining industries is that it play a significant or important role for GDP of the country in mineral rich countries and generation of employments but due to negligence and human greed's mining and its allied activities adversely impacts on environment in the form of pollution of air, water, land, soil quality, loss of vegetation and forest ecosystems. Impacts on human health and habitation has become a matter of serious concern due to mining, the magnitude and significance of impact on the environment depends upon the mineral which is being mined and mining practice. Mining and its environmental impacts are very wide subject to be covered, therefore in this review we cover environmental impacts of opencast mining and processing of minerals (Marble, granite, sandstone, Limestone, Granite,) mainly focused on protentional effects on Air pollution, Water pollution, and impacts on land environment. After reviewing the previous study, it was found that the major environmental impacts of mineral mining and its processing indicate that mining and its allied activities adversely impacts on land and soil of the area, losses of forest cover and depletion of water level and contamination. Dust was a common air quality problem throughout all mining activities; gasses emissions were also serious problems which needs to be focused to adopt sustainable mining practices and strict mining policy to save nature.

Keywords: Mining, Environment Pollution, Dust, Allied, Contamination

INTRODUCTION:

Mineral is a naturally occurring substance which is almost looks solid, crestline, stable and inorganic in nature mineral all together make rocks, formation of these minerals in the earth crust take place due to various geomorphic or catastrophic activities under the earth crust or sedimentation on the ocean floor. Mineral like marble, sandstone, limestone, granite, are common minerals within the geological material which is excavated from the earth for various purpose. These minerals are not

recyclable and not substitutable therefor the demand is

fulfilling only by mining of the minerals. Mineral development which involves exploration, mining and processing, must have caused some damage to surrounding environment. Mining of minerals generate huge amount of waste and processing of these mineral use lot of water and produce waste in the form of slurry which create Air, Soil and Water pollution all together. Most of the impacts due to mining of minerals are being reflect in the form of land degradation, contamination of surface

water and ground water as well in the Air of surrounding areas.

METHODOLOGY

Literature review for this study is done in a systematic manner only published information was used and there is no time and location limits for the literature. Literature from the different locations of the world with different level of studies done for finding of the impacts of mining were accessed, there is no scale limits, the study includes large scale as well as small scale of mining the only limits in this review study is open cast mining we consider only open cast mining covering different location from all the directions, this study is divided into two parts first is result this part includes review of the available literature to extract valuable findings associated with the mining and processing of the mineral in the form of pollution and depletion of the environment and second is discussion of the impacts of mining of mineral on the surrounding environments with respect to Air, Water and Soil Pollution as well as on human health.

RESULT

Mining and processing of minerals:

Minerals like Limestone, Marble and Granite mined out from the main dominant deposits like sedimentary rocks, metamorphic rock, igneous rocks from the mineral rich areas by manual, mechanized or semi-mechanized methods it generates huge amount of waste, quantity of waste generation is depends on the method adopted and quality of mineral.

The Conventional quarrying techniques of blasting leads to the waste percentage of 60% to 70% and lead to uncontrolled

stripping of vegetation cover and subsequent soil erosion

This waste includes odd blocks of various sizes and shapes, unwanted blocks and rock fragments, produced during trimming and shaping of mined out blocks before transporting to processing unit.

Processing of mineral:

Mining of these dimension stone in the form of blocks for the final product these blocks need to be cut in slabs and finishing at processing units. The rough and unpolished block, firstly received from mines of various ranges in weight depend on the quality of mineral, which is unloaded in the yard with the help of cranes for processing to the final product.

Pathway of pollutant to transfer in the environment:

There are number of ways by which pollutants and hazardous material associate with these minerals transferred to the environment. The most common mean of transportation is mining and other is processing

Environmental impact during mining:

The most know negative impact of surface mining is land degradation, loss of vegetation and increase the dissolved and suspended elements in the environment which are important for water quality and air quality of the surrounding area.

The major mining effects discussed are as follows:

- i. Loss of topsoil and vegetation
- ii. Leaching of elements and contamination of surface and ground water

iii. Generation of Air pollutant in the surrounding environment

iv. Depletion of ground water level

Environmental impact during processing:

Huge amount of processing waste generated during cutting, sizing, polishing and finishing up the natural blocks in the form slurry which disposed in the open area create major environment hazards like Water pollution, Air pollution soil pollution as well as health hazards.

DISCUSSION

Impacts on water Resources:

Several studies documented several water qualities changes due to mining and processing of the mineral at various locations. Several studies reported that processing of mineral use huge amount of fresh water and create water pollution from discharging waste in the form of slurry there are four main types of mining impacts on water : acid mine drainage, heavy metal contamination and leaching, processing and erosion and sedimentation (Aboka Yaw Emmanuel et al 2018), The impacts of mining on ground water considered under these areas (a) Lowering of water table (b) Subsidence (c) Reduction of moisture in soil and atmosphere (d) Rise of temperature due to albedo effect (e) Disturbance on hydrological cycle rain and climate. Similarly, surface water is concerned the effects may occur in the form of percolation due to subsidence and intermingled extension of cracks and microcracks network, physical and chemical imbalance, effect on hydrological cycle, rainfall and climate exodus evaporation (Karmakar and Das 2012)

The polluted water may be acidic, toxic and highly turbid, or may contain microorganisms which are hazardous to health, it may cause different water born disease and sedimented and oil content generate turbidity and grease film prevent oxidation in surface water and high turbidity prevent entry of sunlight it led to decrease in photosynthesis of aquatic plants so polluted water effect human as well as animal too, due to mining breaking and degradation of land , derangement in drainage system and other create imbalance in chemical and physical quality of the water (Karmakar and Das 2012) mining and processing facilities and mine spoil sites shows that mine waste constituent sources of metals in drainage water, microprobe analysis of rock samples taken from rock waste dump and exposed outcrops in the Ashanti Goldfields (Obuasi) area show that the waste rocks contain a variety of base metal and metalloid bearing sulphides, together with carbonates (calcite, dolomite, ankerite, siderite), silicates and oxides. The analysis showed that sulphides content in waste rock samples ranged between 0.01% and 3.86% while carbonates ranged from 0.01% to 15%. This study put emphasis on the analysis of sulphides because they constitute the principal custodians of the toxic metals analysed in water samples. The probe results show that sulphides exhibit strong compositional variation defined by their relative trace element content. Fe, As, Cu, Ni, Zn, Sb and Co-bearing varieties constitute the dominant sulphides (Akabzaal et al) studies of marble quarrying on surface water at Kwakuti, Niger state, North Central Nigeria shows that the major contaminants in the surface water at Kwakuti and its environs are Mg^{2+} and Pb^{2+} . The effects of

lead accumulation human health is well known and this has made the surface water in Kwakuti in no way suitable for the drinking either by humans or animals or even for other agricultural purposes such as irrigation due to high concentrations of Pb^{2+} and Mg^{2+} in the water (Ako T. A et al 2015)

Mining of mineral also source of fluoride contamination in the surface water as well as ground water It is evident from the outcome of the study done in Fatehpur Sikri block that the main source of fluoride and salt in groundwater is the availability of salt rich geological formation and hundreds of open stone quarries directly exposed to the surface and precipitated water are escalating weathering and erosion of salt rich minerals, the long-term water-rock interaction within the stone quarries, fluoride and salt released out and then accumulated in the groundwater aquifers in the region. The intake of fluoride above the permissible limit in drinking water is the major reason for both dental and skeletal fluorosis diseases, (Misra 2013). The findings of study in done in Surface and Ground Water Pollution from Mining Activities in Ikpeshi, Edo State, Nigeria shows that Turbidity, hardness, total dissolved solids, magnesium and calcium are very high in concentration, Total hardness was also very high and calcium had the greatest concentration both for fresh water and drinking water respectively. pollutants found their way to the ground and surface water system through pathways such as fracture zones and pore space into the aquifer zone, through run-off, infiltration and percolations thereby contaminating the portable water. (Idris et al 2014).

Effects on Air Quality:

The manufacturing of marble involves cutting and finishing marble obtained from quarries, where specific dimensional marble is prepared for various uses in specialized mills equipped with saws, polishing machines, and others. Marble sawing equipment includes large circular saws, where various types of diamond and other equipment are used for smoothing, polishing, and edging the raw marble. The marble production process includes several steps. Marble blocks are cut into smaller blocks in order to give them the desired smooth shape. During the cutting process about 25% the original marble mass is lost in the form of dust. Processing of marble results in the formation of marble dust, which is suspended in the air and may then, is inhaled by the worker. Mining and Air quality is a serious concern of the mining industries. Mining and its allied activities generate large amounts of material, and waste piles containing small size particles are easily dispersed by the wind, dust emissions occur during each stage of the mine cycle, but especially during exploration, development, construction, and operational activities it produce significant amount of air pollutant (ELAW 2010). Minerals processing through metallurgical processes often results in the emission of NO_x and SO_x . Mine tailings are made up of fine particles it becomes serious problem when dry, as studies done in in Gauteng, South Africa, tailings storage facilities generate dust on windy days that can impact over a wide area, particularly during dry months. In some cases, this can be so bad that residents living close to these old impoundments take refuge in their homes. nuisance originate type of dust cause discolouration, and in some cases permanent damage which is emitted by Coal and iron ore

mines (F. Schwegler 2006). Studies show that suspended particulate matter is the major cause of asthma, lung cancer, cardiovascular diseases and premature deaths in humans. A study at Mukula Mine, Limpopo Province, South Africa showed very high concentrations of dusts at the point where whole rock was drilled before crushing them into several sizes of aggregates. Concentration of SPM at the drilling site was found to be more than the WHO prescribed values, showing that the working people are at health risk. The implications of these dusts on the health of miners depend on the exposure level, the duration of exposure, the frequency of exposure, the chemical and mineralogical composition of the inhaled particle. When workers are exposed to silica dust over a certain period of years, there is always the tendency that these workers would develop silicosis, lung cancer and tuberculosis, (Momoh et al 2013). Increasing level of particulate matter is the most serious problem in the mines area. The degree of impact is also dependent on the size of the particulate matter. Coarse particles result in adverse effects on the lung system while fine particles are deposited in the deeper parts of the lungs and can cause diseases on the health of mine workers (Sneha Gautam et al 2012). Processing of marble generates marble dust, which is suspended in the air and inhaled by the workers. Epidemiological studies revealed that workers exposed to marble are at risk of suffering from asthma symptoms, chronic bronchitis, nasal inflammation and impairment of lung function, (Camici et al 1978). Studies have demonstrated that the high level of environmental pollution by marble dust is observed in all workshops studied for workers not wearing respirators and the poor maintenance of ventilation systems at most workshops.

Lack of awareness of potential health effects of marble dust exposure might have potential health hazards (Gammal et al 2011). These air pollutants reduce air quality and this ultimately affects the people, flora and fauna in and around mining areas. Studies show that SPM and RPM were the major sources of emission from various open pit mines. The annual and 24-h average concentrations of SPM and RPM were higher than the NAAQS at most of the places both in the mining and residential areas (Chaulya: 2005). Studies of granite quarrying show that high levels of particulates generated at the drilling and crushing areas depict them as hazard zones. Moreover, exposure of quarry workers to particulate pollution, coupled with the general non-use of protection gadgets, predisposes them to several respiratory ailments like health problems found prevalent among residents living near quarry sites, (Oguntoke Olusegun et al 2009). Quarrying and stone cutting industries produce high concentrations of particulate matter (dust), which negatively affects agriculture. The deposition of dust resulted in the extinction of different types of trees and vegetation cover along with reduction in crop yields, (Tahseen Sayara et al 2016). It was cited that concentration of particulate matter increases during the summer season in and around the mining areas, which is not suitable for humans. High concentrations of different particulate matters were found in the study area, and this was reflected and confirmed by residents in the surrounding as most of the respondents (70%) confirmed that the air is permanently dusty, and the conditions are not limited to working hours, where higher effects are normally noticed in the summer season (Tahseen Sayara 2016). Site conditions that affect the impact of dust

generated during extraction of aggregate and dimension stone include rock properties, moisture, ambient air quality, air currents and prevailing winds, the size of the operation, proximity to population centres, and other nearby sources of dust. Dust concentrations, deposition rates, and potential impacts tend to decrease rapidly away from the source (Howard et al 1998).

Effect on Land and Soil Environment:

Impact of mining on land environment gets reflected in land-use pattern of the respective area because the more the land gets exposed to erosion by losing its green cover or by getting disturbed otherwise due to mining (excavation, overburden dumping etc.) and related activities, its water resources gets damaged, soils get contaminated, part or total of flora and fauna gets lost, air and water gets polluted and the more damages go on proceeding in accelerated rates and the cumulative effects push the land towards degradation. According to the data generated by the Indian Bureau of Mines stripping ratio varies with the area under mining, , average stripping ratio for limestone mines in India is 1:1.05. For large-scale cement sector with captive mines, the average stripping ratio is only 1.05. This is quite good; however, the generation of overburden varies from mine to mine. Overburden removal from the mine area results in a very significant loss of rain forest and the rich topsoil. Overburden removal is normally done by the process of blasting or using excavators, which results in generation of large volume of waste (soil, debris and other material), (Dr H. B. Sahu & Er. S. Dash 2011). In the study of the potentials of mining lands for agriculture on the Jos plateau, observed that the Ray Field area of the Jos plateau

was rendered derelict and considered “unsuitable” for crop cultivation as a result of the open cast method of tin mining .The study revealed that the mining has adversely affected population of trees and grass species found in the area, because of clearing of site for mining. The decline in the tree density particularly in the mined sites has been attributed to cutting down of trees to give way for the mining (Sahu and. Dash 2011).

Due to mining topsoil drastically damaged if it is not removed separately in the beginning and store at separate place and later use for reclamation of the area. This is particularly necessary due to the scarcity of topsoil in coalfield. Therefore, it is necessary to save topsoil for a latter use in a manner to protect primary root medium from contamination and erosion, and hence in productivity (Ghose and Kumar 2004)

The mining activity in Bijolia has progressively increased from 1971 when it covered only 0.84 km² which increased to 12.045 km² in 1984 and further to 30.839 km² in 1991 . The forest cover decreased from 237.819 km² (38.516%) in 1971 to 174.274 km² (28.385%) in 1984 and then to 127.770 km² (20.714%) in 1991. This amounts to a decrease of nearly 110 km² (47%) in just 20 years. Mining activity has significantly added to the degradation of prime forest land and development of wasteland. Mining despoliation (spoiling) of land is most destructive. In 20 years time nearly 30 km² of land has been directly destroyed by mining activity leaving a big scar on the mother earth, (Singh 2010). Unscientific mining and disposal of quarry waste are the main cause of land degradation, waste including the overburden or weathered waste rock material is dumped anywhere outside the

mine area without planning, that is the main cause of land, Due to mining and processing of mineral dust and suspended particles automatically generated in huge amount, they settled on the earth surface, covering large area of surrounding land pollution further it leads to water pollution and vegetation loss,(Jain 2013)

CONCLUSION

Mining of minerals is important for economic growth of the country as we know it play a major role in GDP of the country it also generate employment and provide raw material to construction industries as well coal mining provide raw material for production of the energy these are the positive aspect of the mining industry however there are also some negative impacts of the mining is also running together likewise as studies done environmental pollution is the major drawback for mining and processing industries environmental pollution includes Water pollution due to contamination or imbalance of the dissolved minerals , Air pollution due to emission of dust and gasses in the Air and noise and vibration due to drilling blasting and heavy earth machinery the major impacts of mining is on land degradation and loss of top soil as well as vegetation and forest cover which ultimately impacts on human health and surrounding animal species.

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