Health Hazards in Workers of the Mining Industry in India

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Abstract— For any industry to be successful it is to identify the Hazards to assess the associated risks and to bring the risks to tolerable level. Mining activity because of the very nature of the operation, complexity of the systems, procedures and methods always involves some amount of hazards. Hazard identification and risk analysis is carried for identification of undesirable events that can leads to a hazard, the analysis of hazard mechanism by which this undesirable event could occur and usually the estimation of extent, magnitude and likelihood of harmful effects. It is widely accepted within industry in general that the various techniques of risk assessment contribute greatly toward improvements in the safety of complex operations and equipment. Hazard identification and risk analysis involves identification of undesirable events that leads to a hazard, the analysis of hazard mechanism by which this undesirable event could occur and usually the estimation of extent, magnitude and likelihood of harmful effects. The objective of hazards and risk analysis is to identify and analyze hazards, the event sequences leading to hazards and the risk of hazardous events. Many techniques ranging from simple qualitative methods to advanced quantitative methods are available to help identify and analyze hazards. The use of multiple hazard analysis techniques is recommended because each has its own purpose, strengths, and weaknesses. As the part of the project work, hazard identification and risk analysis was carried out for an iron ore mine and a coal mine and the hazards were identified and risk analysis was carried out. The different activities were divided in to high, medium and low depending upon their consequences and likelihood. The high risks activities have been marked in red colour are un-acceptance and must be reduced. The risks which are marked in yellow colour are tolerable but efforts must be made to reduce risk without expenditure that is grossly disproportionate to the benefit gained. The risks which are marked in green have the risk level so low that it is not required for taking actions to reduce its magnitude any further.

Keywords: Hazards, Mining Industry, Coal, Mine, Multiple Hazards, Complex Operations

I. INTRODUCTION

Mining is an unsafe occupation wherein labourers are presented to unfriendly conditions that are destructive to individuals. Mining is an old occupation since quite a while ago perceived as being laborious and at risk to injury and infection [1]. The existence pattern of mining comprises of investigation, mine turn of events, mine activity, decommissioning and land recovery. Mining is a multidisciplinary industry drawing on a few callings. To guarantee accuracy in clinical and the study of disease transmission work, it is essential to detail the assignment, as the term excavator is vague. Mining customarily is named metalliferous or coal and as surface or underground. Metalliferous mining can likewise be arranged by the product being mined. During the metallurgical cycle, numerous word related wellbeing perils might happen.

A. Mining Industry in India:

Mining is more than 6000-year-old in India. The remaining parts of some old mine working are observer to these realities. A couple of these working has prompted the disclosure of various critical mineral stores, which are being available time. The most seasoned mine is incorporated lead-zinc mineral stores at Zawar copper store at Khetri and gold stores in Karnataka. Indian mining industry has been a significant mineral maker in Asia and all around the world also.

II. OCCUPATIONAL HEALTH HAZARDS

A. Physical Hazards

Commotion is universal in mining. It is created by strong machines, fans, impacting and transportation of the mineral. The underground mine typically has restricted space and hence makes a reverberant field. Commotion openness is more noteworthy on the off chance that similar sources were in a more open climate.

Openness to commotion can be diminished by utilizing traditional method for clamor control on mining apparatus. Transmissions can be calmed, motors can be muted better, and pressure driven apparatus can be calmed too. Chutes can be protected or fixed with sound-engrossing materials. Hearing defenders joined with ordinary audiometric testing is regularly important to save excavators' hearing.

B. Ionizing Radiation

Ionizing radiation is a danger in the mining business. Radon can be freed from stone while it is released by impacting, yet it might likewise enter a mine through underground streams. It is a gas and along these lines it is airborne. Radon and its rot items emanate ionizing radiation, some of which have sufficient energy to deliver disease cells in the lung. Therefore, demise rates from cellular breakdown in the lungs among uranium diggers are raised. For diggers who smoke, the demise rate is especially higher.

Heat is a danger for both underground and surface excavators. In underground mines, the chief wellspring of hotness is from the actual stone. The temperature of the stone goes up around 1 °C for each 100 m top to bottom. Different wellsprings of hotness stress incorporate how much active work laborers are doing, how much air flowed, the encompassing air temperature and stickiness and the hotness produced by mining gear, chiefly diesel-fueled hardware. Extremely profound mines (further than 1000 m) can present critical heart issues, with the temperature of mine ribs around 40 °C. For surface specialists, actual work, the nearness to hot motors, air temperature, mugginess, and daylight are the chief wellsprings of hotness. Decrease of hotness stress can be cultivated by cooling high-temperature hardware, restricting actual work and giving sufficient measures of consumable

water, cover from the sun and satisfactory ventilation. For surface hardware, cooled taxis can ensure the gear administrator. At profound mines in South Africa, for instance, underground cooling units are utilized to give some alleviation and emergency treatment supplies are accessible to manage heat pressure. Many mines work at high heights (e.g., more noteworthy than 4,600 m), and along these lines, diggers might encounter elevation disorder. This can be bothered assuming they travel to and fro between a mine at a high elevation and a more ordinary barometrical strain.

C. Chemical Hazards

Mineworkers are frequently presented to unsafe synthetic substances.

For instance, the most well-known gathering of synthetics that cause worry in a coal mining climate is polymeric synthetic substances.

Notwithstanding the synthetics, you work in nearness hence proper wellbeing wear and precautionary measures should be taken to limit your body's openness to them. Chances incorporate synthetic consumes, respiratory issues, and harming.

Every compound has a novel arrangement of dangers and should be dealt with appropriately to guarantee laborer wellbeing, so bosses need to direct danger evaluations to set up accepted procedures.

A standard working strategy (SOP) that tends to the utilization of right private defensive hardware, safe taking care of, safe use, and legitimate removal ought to be set up [2].

Ventilation is additionally a significant element in limiting openness, just as broad housekeeping and neatness. Intensive preparing and penetrates ought to be directed with respect to the organization's spill reaction plans and substance cleanliness plans.

D. Biological Hazards

The risk of tropical diseases such as malaria and dengue fever is substantial at some remote mining locations. Leptospirosis and ankylostomiasis were common in mines, but eradication of rats and improved sanitation has controlled these hazards effectively in the developed world. Cooling towers are commonly found on mine sites. Regular microbiological analysis of the water is necessary to detect Legionella contamination or high concentrations of other heterotrophic microorganisms

E. Ergonomics Hazards

Although mining has become increasingly mechanized, there is still a substantial amount of manual handling. Cumulative trauma disorders continue to constitute the largest category of occupational disease in mining and often result in prolonged disability [4]. Overhead work is common underground, during ground support the suspension of pipes and electrical cables, This can cause or exacerbate shoulder disorders. Broken ground is often encountered and can cause ankle and knee injuries. Most mines operate 24 h per day, 7 days per week, so shift work is very common. There has generally been a trend towards 12 h shifts in recent years. Fatigue in relation to shift work has been subject to considerable investigation in the industry. Sleep deficits, which might be expected in hot locations, have been shown to cause impairments of cognitive and motor performance among drivers from other industries. The remote control of mobile equipment in underground mining has been introduced to reduce the risk of fatal injuries from rock falls. This has required attention to cognitive ergonomic issues, many of which are similar to those found in metallurgical plant control rooms. Proximity safety devices have also been developed.

F. Psychosocial Hazards

Drug and alcohol abuse has been a difficult issue to deal with in mining, but policies and procedures are now in place in most large mining operations. Debate continues about how to measure psychophysical impairment. Nevertheless, mining operations commonly require the measurement of urinary drug metabolites and breath or blood alcohol on pre-employment and following accidents. Remote locations are common in mining. Massive ore-bodies, such as those at Mount Isa in Queensland, Australia that have been mined for 80 years, justify the establishment of a city. Contemporary finds, however, tend to be smaller and do not justify the establishment of permanent townships. As a result, there has been a trend towards ‘fly-in-fly-out' operations, with mine employees separated from their families and communities during work periods. Expatriate placements are also common in mining and the associated psychosocial hazards have been reviewed recently. Unfortunately, fatal and severe traumatic injuries continue to occur in mining and often have a profound impact on morale. Post- traumatic stress disorders sometimes develop in witnesses, colleagues, and managers. Registered managers often feel personally responsible for such injuries, even in the absence of negligence, and face the ordeal of government inquiries and legal proceedings.

Process type	Contaminated type	Contaminated example
Solid operation	Dusts	Cement
Mixing		Quartz-free silica
Separation		fibrous
Extraction		
Crushing		
Conveying		
Loading		
Bagging		
Pouring		

Table 1: Potential health hazards operation

III. Occupational Risk and Disease

Mining is one of the most hazardous employment sectors despite the considerable efforts in many countries to implement and maintain occupational health and safety. The graph of death, injury and diseases remain highest amongst the world's mineworker. Over and above accidents, many other adverse health effects associated with mining industries are caused by the inhalation of airborne pollutants which are not controlled at sources. The mining workplace may include heavy work, exposure to a chemical. Noise, vibration, heat and cold stress, work at high altitude, etc. Smallest underground mining typically works in unsuspected tunnels, drilling and removing rocks with hand tools and carrying the

ore surface in sacks. In this mining work, most common accidents are trips or trails, being hit by machinery or moving objects and cave in the rock falls. The biggest health risk is exposure of silica dust. It causes silicosis particularly in gold miners, mercury and other chemicals. The effect of noise and vibration, poor ventilation resulted in heat, humidity and lack of oxygen, inadequate wok space and the incorrect use of equipment while other monplace health problem include poor sanitation and lack of clean water, malaria, typhoid, dysentery, malnutrition, substance abuse, tuberculosis and sexually transmitted infection including the human immunodeficiency virus that can lead to acquired immunodeficiency syndrome. These can reach epidemic proportion when make shift camps arise, for instance gold rush mining.

A. Silicosis and Coal Workers Pneumoconiosis

Mining work increase the chances of exposure to respirable crystalline silica and respirable coal mine dust, which cause a spectrum of lung diseases. Respirable silica dust cause silicosis, chronic obstructive pulmonary diseases and lung cancer with increased risk of tuberculosis (TB), chronic renal failure and several autoimmune diseases. Respirable coal mine dust is complex mixture of material causing coal workers pneumoconiosis, silicosis and Chronic obstructive pulmonary disease (COPD) [4].

1) Prevention:

The measure step for prevention for silicosis and coal worker's pneumoconiosis (CWP) requires that worker's exposure to silica and coal dust should be eliminated or reduced. This includes dust control measures using sustainable technology in the hierarchy manner such as local exhaust ventilation, process enclosure, wet technique and elimination or substitution to limit exposure to respirablesilica and coal dust. This prevention method is not only for silicosis and CWP but also in the prevention of TB since exposure to silica dust and silicosis, both are risk factors for developing TB

B. Asbestosis

Asbestosis and other asbestosis-related diseases are disorders of the Jung and pleura caused by the inhalation of asbestosis fibers. Asbestos is a set of natural silicate minerals commonly known by their color as blue asbestos, brown asbestos, and the most common white asbestos is also called as chrysotile.

1) Asbestos

Related diseases include non-malignant disorders such as asbestosis (pulmonary fibrosis), diffuse pleural thickening, pleural plaques, pleural effusion, and rounded atelectasis as well as lung cancer and malignant mesothelioma. The symptoms of asbestos and other related diseases do not manifest until after an appreciable latency, often several decades. Sufferer of asbestos malignancies experiences severe shortness of breath that eventually leads to respiratory failure and death [7].

2) Prevention:

Serious health issues of asbestos mining workers, to avoid the asbestos-related diseases, must be substituted with known alternatives. The international organizations, WHO, ILO, and ICOH, have made declarations aiming at a total ban on the production and use of asbestos. By 2014 widespread and large-scale use of asbestos was banned in more than 50 countries worldwide. Countries such as China, India, Brazil and Indonesia have continued mining and widespread use of asbestos. In most low-income countries, no decrease in asbestos use has been seen. The exposure of workers to asbestos fibers should be minimized through methods for reducing dust particles. A particular problem exists in small scale mining and industries and the informal sectors where limited resources exist to control respirable exposure dust and no authority are there to check regularly [7].

C. Cancer

The cancer diseases lead to death and disability in a global frame. Industries and occupation increase the number of cancer death, which include construction, metalwork, mining land transport, roofing, road repair and construction, printing, framing, machine manufacture transport equipment, nonferrous metals and metal products and chemicals. Numerous studies have shown association between lung cancer and various exposures during mining activities [7].

1) Prevention:

By improving working conditions. The recent global burden of diseases analysis, using data of 2015, found and estimate 4,89,000deaths globally due to occupational carcinogens in IARC group 1A human carcinogens. Quantitative risk assessment is an important tool in the prevention of occupational cancer because different carcinogens produce variable level risk and there are disparities in the risks incurred by people exposed under different circumstances.

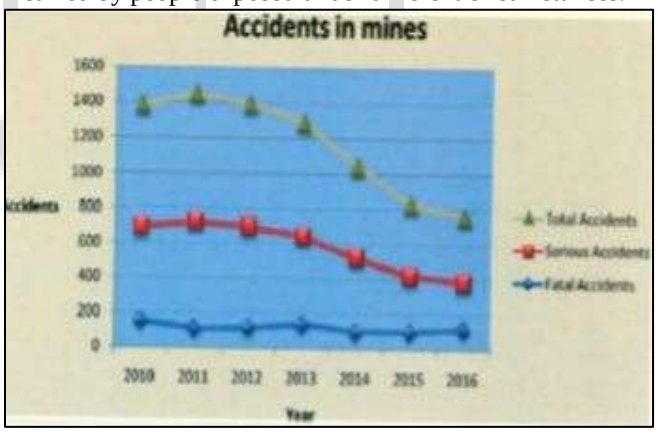

Fig. 1: Accidents trends in mining (2011-2016)

D. List of Occupational Disease and Statistics

As per third schedule of the factories Act 1948, following occupational diseases are mentioned [6]:

- Lead poisoning including poisoning by any preparation or compound of lead
- Lead-tetra-ethyl poisoning.
- Phosphorus poisoning.
- Mercury poisoning.
- Manganese poisoning.
- Arsenic poisoning
- Poisoning by nitrous fumes.
- Carbon bisulphide poisoning.
- Benzene poisoning, including poisoning by any of its homologues, their nitro or amide derivatives.
- Chrome ulceration
- Anthrax.

- Silicosis,
- Pneumoconiosis.
- Poisoning by halogens or halogen derivatives of the hydrocarbons of the aliphatic series.
- Pathological manifestations due to- (a) radium
- Toxic anaemia.
- Toxic jaundice due to poisonous substances.
- Oil acne or dermatitis due to mineral oils and compounds containing mineral oil base.
- Byssinosis.
- Asbestosis.
- Occupational or contact dermatitis caused by direct contact with chemicals and paints. These are of two types, that is, primary irritants and allergic sensitizers.
- Noise induced hearing loss (exposures to high noise levels).
- Beryllium poisoning.
- Carbon monoxide.
- Coal miner's pneumoconiosis.
- Phosgene poisoning.
- Occupational cancer.
- Isocyanates poisoning.
- Toxic nephritis.

IV. Effect of Mining on Environment

Mineral are the natural resource that play important role in the economic development of country but due to the mining process, some adverse effects occur on our environment and human health as well.

Impacts on water resources: water is an important resource to sustain life on the Earth but the continuous mining process produce adverse effects on water quality and availability of water resources within the project area [8]. It leads to the emission of repairable particle in the atmosphere, which cause air pollution. Under the mining process, trace elements eg. CO, Pb, Cd etc lead to the contaminated the surface water. Underground water is also contaminated due to seepage and infiltration of leaching drainage.

Mining leads to the degradation of soil quality, fertility and makes it toxic. Due to trace element, the natural vegetation is adversely effected.

V. Legal Provisions for Occupational Safety and Health

The major legal provision for the protection of health and safety of the working population are the factories Act and Mine Act. The factories act, 1948 deals with occupation health and safety as well as welfare of worker working in a factory. The legal provisions for mining industry comprise [6]:

- Mine Act 1952, and 1955
- Mines rules. 1957 * Coal mines regulation, 1961
- Metalliferous mines regulation
- 1989- Oil mines regulation.
- Mines rescue rules 1985
- Mines crèche rules 1966 + Manufacture, storage and import of hazardous chemicals rules 1989, under the environmental protection act 1986
- Metalliferous mines regulations 1961
- Electricity act 2003
- Factories act 1948: chapter III and IV
- Land acquisition mines act 1885
- The coal mine (conservation and development Act 1974.

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