
Occupational Health Hazards in Mining in Pakistan: An Overview

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Abstract:

This paper examines the occupational health and safety issues (OHS) of Pakistan's mining sector. Mining is an important sector in Pakistan after agriculture. Although OHS standards has been improved but the progress is slow. Therefore the need is for significant rather incremental change. Being a developing country, there is a dire need for effective identification and response to the OHS issues and problems in order to get maximum productivity which will ultimately support economic growth. Efforts are made to highlight the main issues currently faced by the miners which are concerned with the occupational health and safety of laborers above and below the grounds. Continuous struggle to improve OHS and to respond to changes in the sector is constrained by lack of training, inconsistency in risk management, guidance for junior, small and artisanal miners and poor/ absence of holistic approaches to risk treatment. In the current review paper sound remedial and control measures are recommended to minimize the ratio of injuries and reduce the intensity of accidents.

Key words: Occupational Health Hazards, mining, Pakistan

Introduction

Globally the responsible authorities are striving to minimize occupational hazards. It's an emerging trend in Asia, America and Europe to stick to innovate those practices while banning few to maximize the health and safety conditions at workplace accompanying with a significant decline in percentage of risks and accidents [1]. Compliance with health and safety legislation not only help to manage the risks linked with working conditions of the laborers but on the other hand it boost up the moral as well as helps in high yield and productivity [2].

Mining industry is considered as the back bone in GDP growth in majority of Asian countries. Besides its huge share it pose serious threats on environmental and occupational scales. Consisting of series of steps; from discovery to extraction of raw materials below and above the ground, each process has many hazards and risks associated with it. Toxic and hazardous emissions produced due to extractions from the mines are released directly into the atmosphere and plays its part as a critical source of air and water contamination as well disturbing the topography and chemistry of the major ecosystems i.e. Terrestrial and aquatic.[4].

Pakistan is an agricultural country but due to lack of access of resources to layman, people are changing their source of income. Pakistan is blessed with significant and important ores of rare elements and minerals covering 600.000 sq km area. Pakistan is exerting its maximum effort to effectively utilize this resource and emerge as a prospecting area for mineral explorations. Mining is becoming one of the highly populated profession in Pakistan. Mining has wide scope in Sindh and Baluchistan province as compared to KPK and Punjab when compared with number of active mine Pitts and ores.

Mining is an ancient profession having its roots in era back to the origin of mankind. It is commonly described as

being grueling and responsible for the several health diseases and issues. It is considered to fall in the category of perceived hazardous occupations. Although Open pit mining offers less health hazards when compared with underground mining but still, whether done underground or above ground, mining offers unlimited potential hazards due to number of working tools and hazardous and dangerous working conditions.[3]

When mining started back in 1880's in the era of the industrial revolution miners had to face life threatening situations, though the hazards are decreased in quantitative and qualitative terms with the passage of time due to technological and ergonomic advancements incorporation in the workplaces but still hazards and issue do exist. Severity of hazards depends upon the type of minerals being extracted, geological conditions of that area, techniques that are employed for mining and the overall health status of the workers involved in mining.

The basic mining activities are:

Exploration

The first phase in the mining cycle is Exploration and is considered as the most critical process on which the whole cycle is dependent. Exploration activity is carried out all over the Pakistan and faces number of environmental challenges depending upon the natural climatic and geological conditions of the area i.e. plain lands in Punjab, mountains in Baluchistan, plateaus in KPK and deserts in Sindh. It is commonly carried out by workers in small groups at an isolated place with small field camps which also serves as rest rooms at night. It basically requires self-sufficient and self-supportive crew. Fixed crew's work duration can vary from few days to several weeks in the same area under severe environmental conditions which aggravates psychological problems.

Open- cast Mining

Open-cast mining also known as surface mining is involved with mining activities above ground. The common sources of injuries in open cast mining are lifting, loading and storing, carrying the crude material, waste, supplies and ores. The main reason for these injuries are unsafe procedures, lack of coordination and PPE, improper working routines and faulty judgments. Unbalanced, poorly maintained and cluttered walkways add to the list of injuries and accidents in the form of slips and falls.

Underground Mines

Mining below the ground surface is the most dangerous and hazardous profession when it comes to occupational health and safety of the workers. The injury aggravating sources are roof falls, unpaved pathways, heavy tools, objects falling /slipping, explosives, fires, dust and asphyxia by natural gases. Greatest share in the mining accidents is possessed by stone falls.

Occupational Health and Safety issues in Mining Industry and Possible control measures

Current issues related to occupational health and safety existing in mining in Pakistan are:

Physical Hazards

Physical injury is the one of the most persistent threat for a miner. The impact of injury can be trivial or fatal it can even have the long lasting effect on the life of miner. Common sources of physical hazards are roof falls, explosions, entrapment, sudden poisonous emissions, irregular working surface inside the mines, improper lightning conditions, landslides, ionizing and non-ionizing radiations, mobile equipment, interruptions in mining operations, breakdown of equipment, and mental stress due to noise [5].

Improper work trials can cause the severe ergonomic problems in the workers working underground mines. Khuwara mines in Pakistan have large trolley dragging pathways which are at some places are not even properly illuminated. This may result in sudden collision of the mobile equipment and workers. These incidents can be avoided by changing the load dragging techniques from manual to automatic. This will decrease the workload on one hand and results in less ill health effects to workers.

Hearing loss is the ultimate result when the workers are exposed to uncontrolled levels of noise. Every fourth worker is the victim of this disease. Long drilling hours, stone cutting, transporting, blasting, milling and sorting of the mine raw materials are the common noise generating activities in underground mines. Production of several megawatts of electricity via large diesel electricity generators also poses noise hazard. These activities combined with the confined working environment leads to mental stress that might prove fatal for workers with low temper. This can be controlled by developing durable and practicable noise control patterns for mining equipment and evaluating the short-term and long-term effectiveness of noise controls by acquiring surveillance data, e.g. using conventional means of controlling machines, muffling the engines, quieting the hydraulic machinery, hearing protectors, applying noise control techniques on the pathway and on the source.

Sudden and extensive rock failures occurs due to high horizontal stress in the mines. It basically effects the natural posture, structure and balance of mines and the ribs like cage of it. High horizontal stresses produce extensive and sudden rock failures. Which results in falling off roofs. This defines that lack of coordination and maintenance may lead to cause entrapment and serious injuries to the miners. During 2010, in coal mines of Baluchistan, roof fall accounts for 21% of all the fatal accidents. This can be reduced by removing the pillar from the

panel's one side with the advancement of panel that will create a cave like situation decreasing the horizontal stress across the panel. The best way to reduce or eliminate the horizontal stress is to remove the pillar from panel's side and forms another cave like structure across the whole panel.

Extreme weather conditions in Baluchistan and Punjab pose serious health issues to miners. Other than naturally induced temperature changes, heat and humidity changes can be induced by the rocks and minerals in mines located at high depths. Both underground and surface miners are exposed to heat hazards. . Rocks themselves are the principal source of heat in underground mines, there occurs increase of 1° C in the rock temperature with every 100 meters of increase in downward distance from the earth surface. Physical activities of the workers inside mine, aeration, ambient air humidity and temperature, heat produced by the equipment being used in mines (mostly fuel consuming equipment) are the other sources of heat in underground mines.

High heat and suffocation can provoke fatal heart problems. Continuous sweating and agitation due to lack of temperature regulators increases the dissatisfaction of miners with their working conditions and leads to permanent stress which becomes part of their daily behaviors. This can be lessened by using the heat produced by the machinery involved in cooling down the environs. Provision of adequate amount of cold drinking water and showers can also be helpful in reducing the heat stresses.

Ultraviolet radiation increases the threat of skin cancer in ground workers, it particularly introduces melanoma. Ultraviolet radiation may cause eye infections like cataracts. This can be prevented by minimizing the exposure to sunlight and employing relevant PPE's.

Radiations or more specifically ionizing radiation is a threat to health and safety of workers in mines. The most hazardous radiations are from plutonium 238, cesium 137 and

radon. Radon and its decay products emit ionizing radiation, exposure to radioactive emissions may cause respiratory diseases and reduces the workers strength by imparting serious damages to his health. In Baluchistan and Sindh coal mines concentration of the Radon emissions varies from 121-408 Bq m³ under controlled conditions. But in case of any interruption in future this may lead to conversion of their status from "safe from radon related hazards" to be posing dangers of radon related health hazards and will cause lung and bronchial cancer [6]. It can be controlled by certain technological measures like proper mine ventilation, proper personal protective equipment (air purifying tanks, Masks, etc.)

Continuous vibration in the mines causes the spinal cord disorders. It may also cause temporary/ permanent numbness of whole or part of involved body organ (hands, thumbs, fingers). Vibration is produced mostly while drilling and moving vehicles. Poorly maintained roads, pathways for transportation of goods in mines and walls contribute to vibrations.

Biological Diseases

Mining is also linked with poor working conditions with the extremities exposed to biological hazards. Biological diseases varies from area to area and person's immunity against them. In underground mines the most common sources of disease are poor waste management strategies, contaminated drinking water, migrant workers and careless attitude of infected workers.

Among the various dangers involved are the threats of insect bites, minor wounds and critical injuries. Mining is also working with poor limbs posture and exposure of limbs to "everything" during work. So the major risks and hazards involve in this case are snake bites, inflammation to any chemical, limb injuries etc.

Occupational exposure to airborne and dust particles are the leading causes of increasing rate of respiratory diseases in mine workers in Pakistan. Continuous exposures to dust weakens the bronchi systems and become the main reason for asthma, and tuberculosis. High intensity of respiratory problems can develop lung diseases like pneumoconiosis (dusty lung).

Respiratory failure's impacts can be lessened by reducing the direct exposure of miners to dust and airborne particles and provision of protective personnel equipment like masks and pure air supplies. In addition to these Pakistan should start an active program to establish a system that will decrease the duration of workers exposure to coal and other PM (2.5 & 10) generating mines and improvements in the surface transportation of equipment, roof bolters, and mining equipment for surface mobile workers.

Ill hygienic conditions in mine also effects worker efficiency and leads towards high rate of absenteeism which ultimately effects the productivity. Recently many mine workers (else than the common people) suffered from dengue virus in Pakistan. Malaria is considered as the most common disease for the miners. Leptospirosis (Weil's syndrome) and ankylostomiasis are still in mines in remote areas where there are poor hygienic conditions are present. Exposure to fungi or mold can also lead to bad health conditions.

Exposure to certain bacteria also raises significant health concerns. Neurological syndromes and elevated birth defects have been found among mine workers contaminated by the toxic bacteria, sometimes ending in death. Deaths and injuries via biological vectors can be decreased by maintenance of proper health and hygienic conditions, pre-employment checkup for viral diseases and periodic vaccinations of workers.

Chemical Hazards

From the long list of chemicals present in the mines the one with potential to threat human activities is the "dust particles".

Dust particles ranging from the size of 0.5- 5 micron meter, get attached with the nasal opening and enters the breathing system and penetrates into the lungs. These are present mostly in mines where the rock is highly siliceous and are considered as free silica [7].

Diseases imposed from the particulate matter and crystalline silica are not something new but they still persist in mines and effects miners in a very cruel way. Exposure for long durations can lead to diseases like pulmonary disease, renal disease, rheumatoid arthritis and high threat of lung cancer. Crystalline silica usually produces silicosis during drilling. This can be controlled by making the drilling process bit watery, in this way silicosis emissions will be suppressed and they won't be able to spread. Chemical hazard involve in the coal mining in Pakistan is coal dust that causes black lung disease.

The term "asbestos" is used for fine fibrous of needle-shaped elongated crystals of serpentine, zeolite, amphibole and some vermiculite minerals [8]. Several varieties of amphibole are inhaled cause highly carcinogenic diseases mostly asbestosis, lung cancer, mesothelioma and pleural plaques. [9, 12, 13].

In Riko-deq (Baluchistan) workers are effected by the Mercury release from the gold mines. It is a serious threat of young workers as well as for the near-by community. High concentrations of mercury in blood, hairs and urine is found in gold mine workers and caused taxia in young workers [10]

Prolonged exposures to diesel and methane without the protective equipment causes nausea and head-ache. Sulphur dioxide from the mining is itself threatening and can result in fatal outcomes when combine with water vapors in the atmosphere and it also produce acid rain. Acid rain provokes the worst diseases in human beings as wells as it effects plant growth and contaminate the water resources. It can also cause Broncho-spasm. Hydrochloric acid which is used in core sample

analysis during the drilling and explorations is an open invitation for accidents.

The mining industry is heavily dependent on chemical usage for its major operations. So there is dire need that it should show compliance to national and international chemical legislation such as the REACH (Registration, Evaluation, Authorization and restriction of Chemicals) regulation, introduced by the European Union in 2007). The effects of chemical emissions from the mines are numerous and range from minute cough to severe skin and respiratory diseases.

Ergonomic Hazards

Ergonomics was not considered an important area when concerns were shown regarding workers health and safety and limiting it to chemical, biological and physical hazards. But recent advances in the OSHA have proved the impacts of failure of ergonomics on the workers. Ergonomic problems rise from the long shifts, higher workloads, poor task understandings, less task variation, monotonous working posture for long hours, vibrations. Whole-body vibration exposures for longer duration via operating machines and vehicles is major ergonomic problem that resist miner to give his hundred percent 24/7. To accommodate these and other linked problems companies are establishing new programme to train the workers and modify the machinery as much as possible with in the capability of the employers to make the working conditions suitable for the workers [11].

Emerging ergonomic issues in mining in Pakistan are mainly arising because of the drive for high productivity that is supposed to achieve via changes in work practices. Now in many mining jobs, shifts mostly range from 10-12 hours with high workloads. It triggers stress and fatigue among the long shift workers and doesn't fulfill the main reason behind these long shifts. This practice and other similar pre-scanned and analyzed changes in work practices are the basic obstacles

when concern is shown that why productivity is not being increased. Though in many mines heavy physical work by the workers has been reduced but still many functions are being carried out manually that increases the risk of ergonomic problems in mine workers e.g. dismantling and erection of conveyor systems, manual installations of overhead pipes, cleaning and maintenance of machinery inside mines, ventilation and installation of roof supporting systems.

Common ergonomic injuries in mining are knee and foot injuries due to kneeling, squatting and crawling in low seam mines, by extending their range these workers can face SSF i.e. slipping, stumbling and falling accidents which purely depends upon the workers activity and his/her age.

Musculoskeletal disorders include the injuries of nerves, tendons, supporting structural (inter-vertebral disks) and muscles. It occurs from the heavy work load, vibration, pushing and pulling heavy weight objects; prolonged and awkward postures; continuous forced movements of the organs, monotonous work and repetitive, prolonged exertion of the hands. These activities highlight a wide range of disorders whose severity and intensity can be marked as mild, chronic, periodic symptoms to continuous illness and debilitating conditions. Examples of MSDs include low back pain, tendonitis, and carpal tunnel syndrome

Psychosocial hazards

Mining is a job that demands long and awkward working hours. Majority of miners remain not in-touch with their families for longer durations due to nature of their work. As they are away from home so loneliness, homesickness and isolation attacks them more frequently. These feelings aggravate anxiety and restlessness in workers and also in their families which results in bad effects on their personal lives. Mining and its relevant activities are linked with migration, mostly owing to the great distances between workers home and their work places i.e. the

mines. This ultimate loneliness and single life put miners to various risks for example malnutrition and exposure to sexually transmitted diseases.

Due to lack of standard trainings and orientations, workers may be exposed to number of hazardous situations and psychological diseases related with darkness with continuous tampering of the soil and rocks gets deeper and deeper.

Violence is not uncommon in places with large number of staff, which when becomes serious, took the shape of bullying and mobbing, which exposes the workers to permanent stress scenarios till the issue is resolved. This situation may have a negative impact on the personality of the child labors working in those mines.

Unfortunately, serious (sometimes fatal) and severe traumatic injuries are part of mining activity and would continue to occur in mining. This could have a devastating impact on morale of the workers. People, who witnessed their colleague suffering any fatal injury, will be affected by it too. This will result in post-traumatic disorders. The top managers (at the time of any injury or accident that occurred in the area of their responsibility) blame themselves for such incidents and if they rescue themselves from the self-blaming phase they will still be afraid of any legal proceedings and official inquiries that might be set upon to investigate about the accident.

Different psychological trainings should be imparted periodically to help to shun way stress and anxiety causing feelings from the minds of the workers.

Conclusion:

Current requirements for health surveillance of workers in the mining industry are deficient to large extent. The application of sound health and safety techniques in mining industry of Pakistan will enhance the efficiency and effectiveness of miner performance which will ultimately lead towards achieving high

productivity targets and safe working conditions. The cost of implementation of health and safety conditions in mining industry should be considered as an investment with long term benefits. Implementation of occupational health and safety management (OHSM) rules and regulations is the only pathway for the companies that have an urge for sudden boom in their yields to achieve their targets.

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